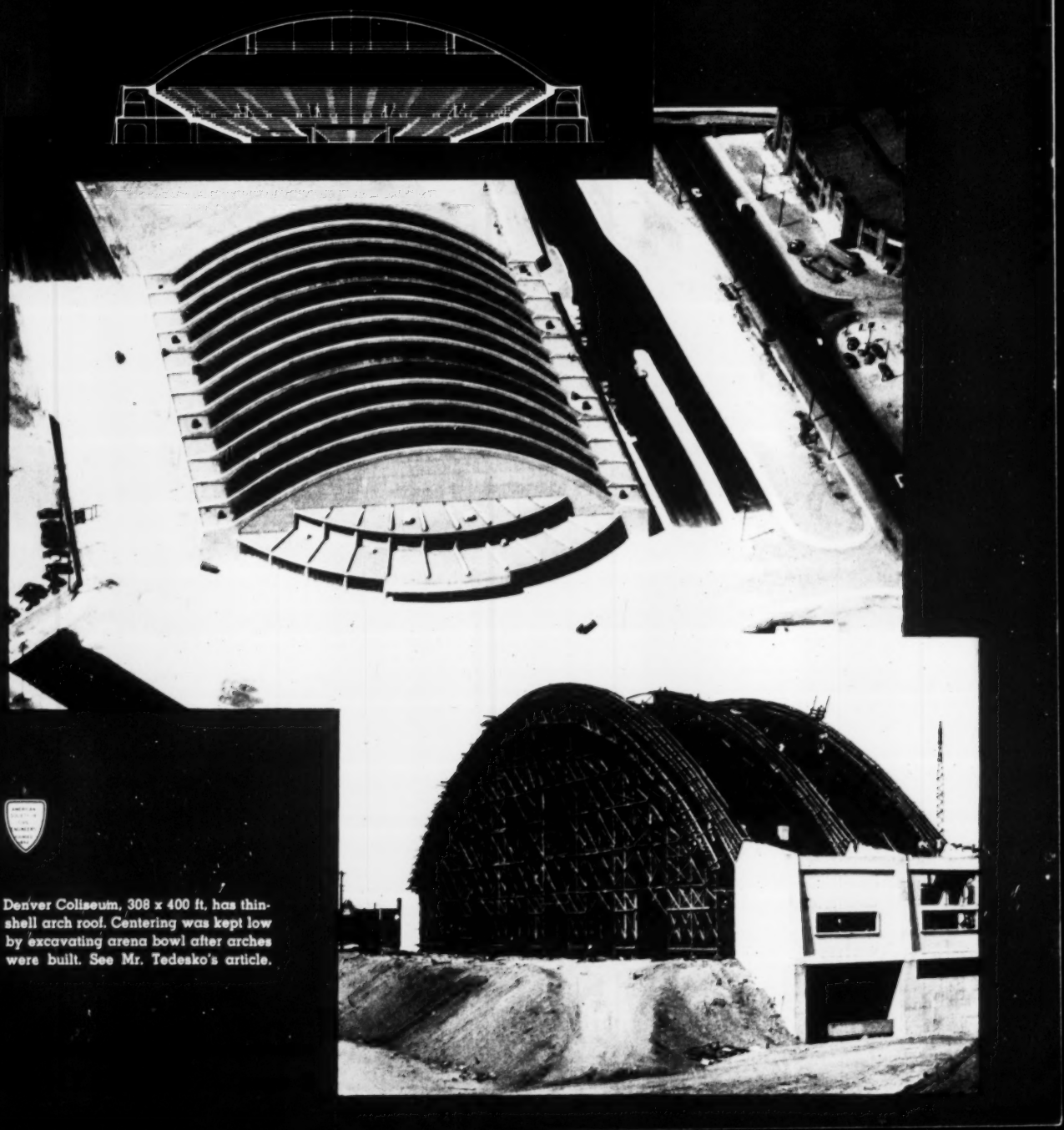
CIVIL ENGINEERING



Denver Coliseum, 308 x 400 ft, has thin-shell arch roof. Centering was kept low by excavating arena bowl after arches were built. See Mr. Tedesko's article.

Raymond Features!

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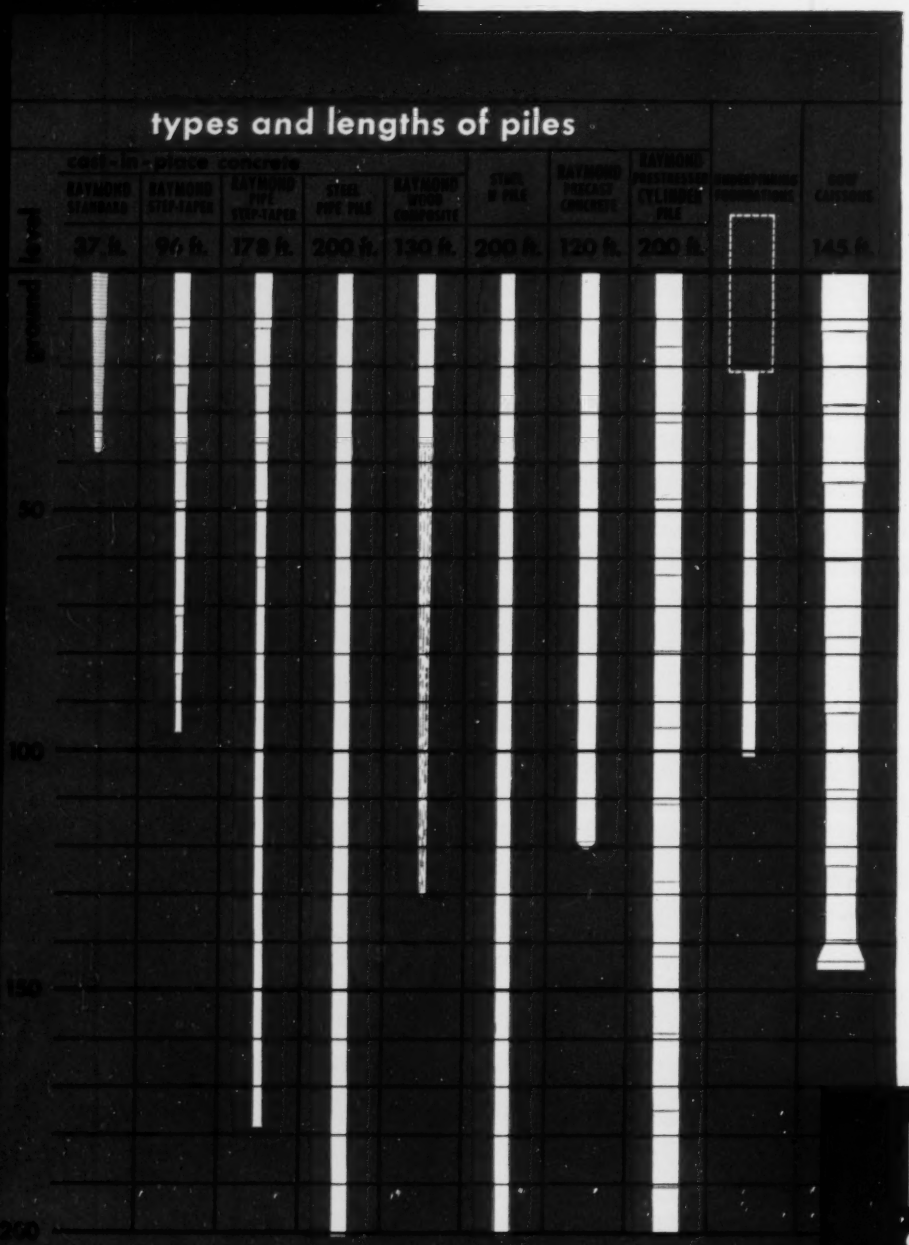
A Raymond PILE TO MEET EVERY NEED



WHETHER you are building a bridge, a skyscraper, a wharf or a dam, there's a Raymond Pile designed to fit your particular needs. For the past 56 years the Raymond Concrete Pile Company has been installing foundations around the world under a wide variety of soil conditions.

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Only Clay Pipe is completely unaffected by these 16 common industrial acids

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SULFUROUS ACID
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JULY 1954

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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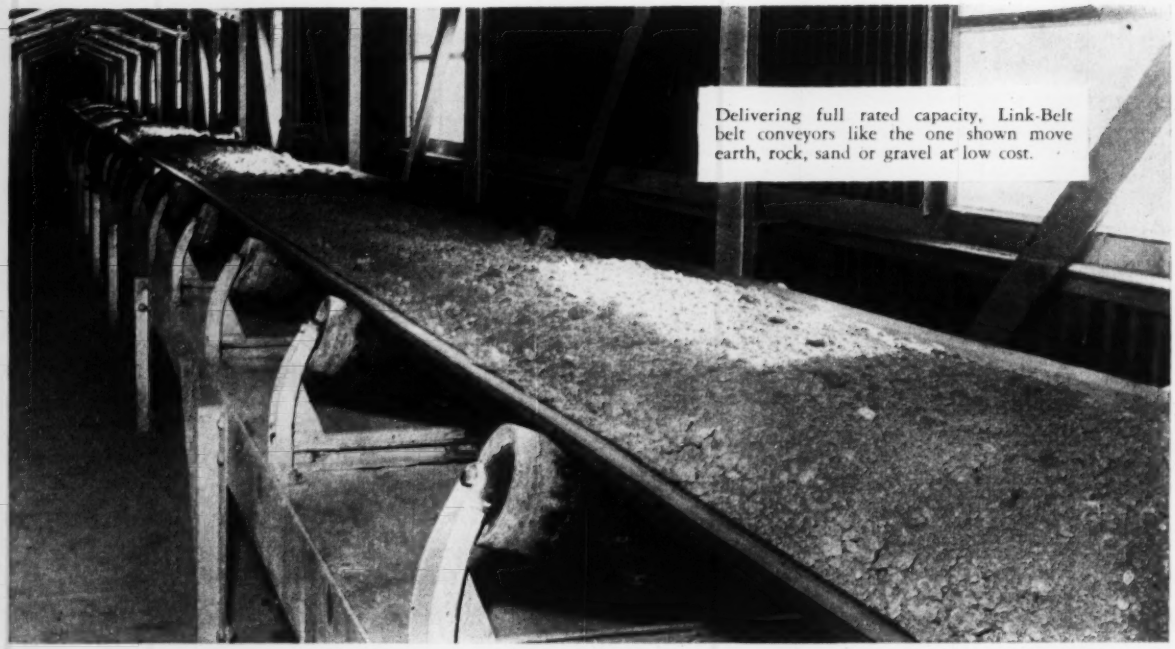

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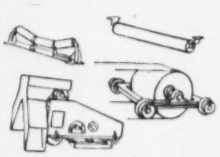

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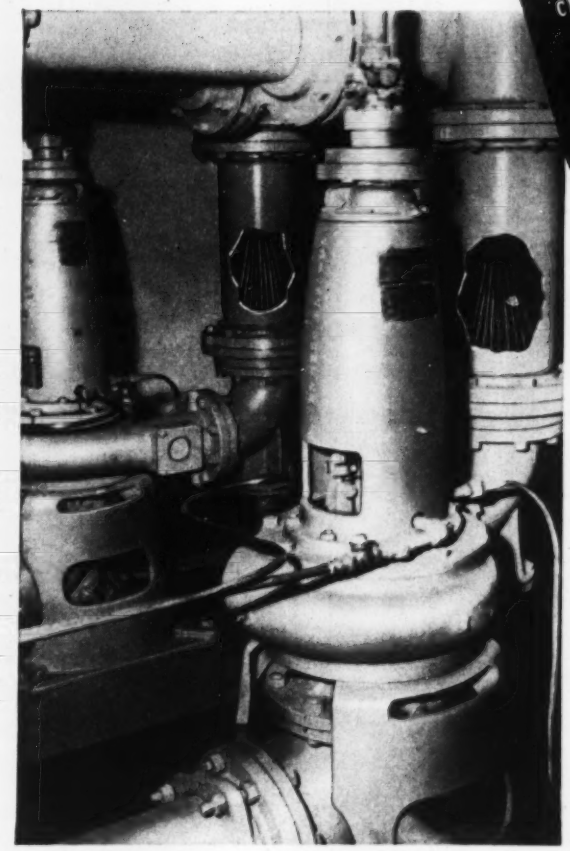

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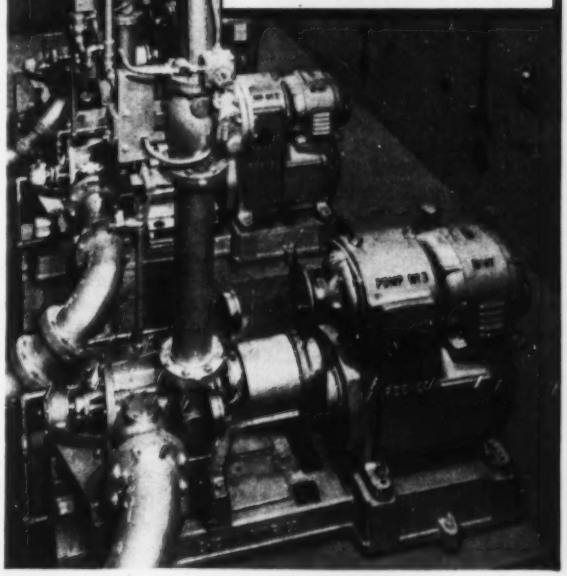
Flush-Kleens can't clog because rags never reach the impeller. Specially designed strainers in the discharge line retain all coarse matter. Sewage flows over the strainer and through one of the pumps to the wet well. When the pumps operate alternately they pump only strained sewage. No rags or coarse material ever pass through the pump casing. Each strainer is automatically flushed clean during its pumping cycle.

One of 11 Flush-Kleen Lift Stations installed in the City of Portland, Oregon. The discharge line has been cut away to show the strainer. These stations were designed by Stevens and Koon for the Engineers Portland Sewerage Project.

CHICAGO SEWAGE EQUIPMENT

SCRU-PELLER Sludge Pumps

OVER 8,000 IN SERVICE



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Three of the 27 Scru-Peller Pumps installed at the Hyperion Sewage Treatment Plant, Los Angeles, California. Board of Public Works and Metcalf & Eddy, Engineers.

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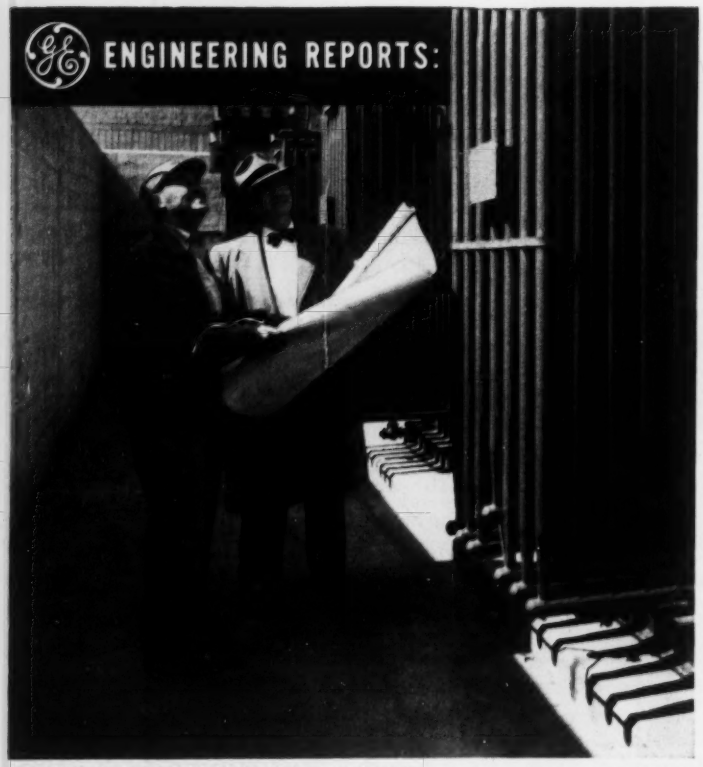

PROJECT CO-ORDINATION of electrical equipment for new pumping stations was handled by D. H. Bixby (right) of G.E.'s Louisville office, working with J. C. Jones, field supt., Central Contracting Co., and Marine Electric Co.

G-E engineering service helps speed Louisville flood control

Expedites construction of 4 pumping stations by prompt delivery of all G-E equipment

In the $24,475,000 Louisville flood control project of the U.S. Army Corps of Engineers, General Electric project co-ordination service, in addition to application engineering, played an important part. Through this service, all G-E power distribution equipment ordered for four of the project's pumping stations was delivered either on or ahead of schedule. This helped the electrical contractors, Marine Electric Co., and the general contractors, Central Contracting Co., to work at top efficiency, expedited construction, and earned the praise of both the Army engineers and contractors.

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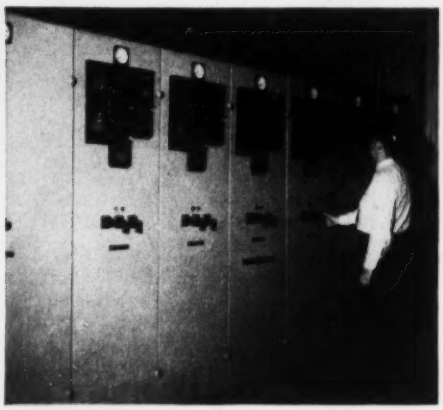
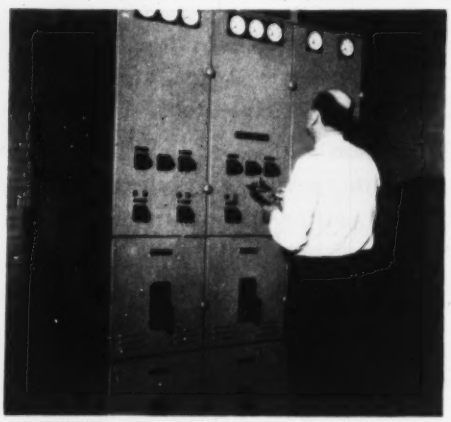
ENGINEERING ASSISTANCE on the project was made available to U.S. Army engineers through F. G. Perkins (center), G-E sales engineer.



COMPLETE CONTROL of Shawnee station is provided by G-E 2400-v metal-clad switchgear consisting of 6 circuit breaker feeder sections.



INCREASED PROTECTION at the project's 34th St. pumping station is provided by 480-v G-E switchgear with 6 drawout air circuit breakers.

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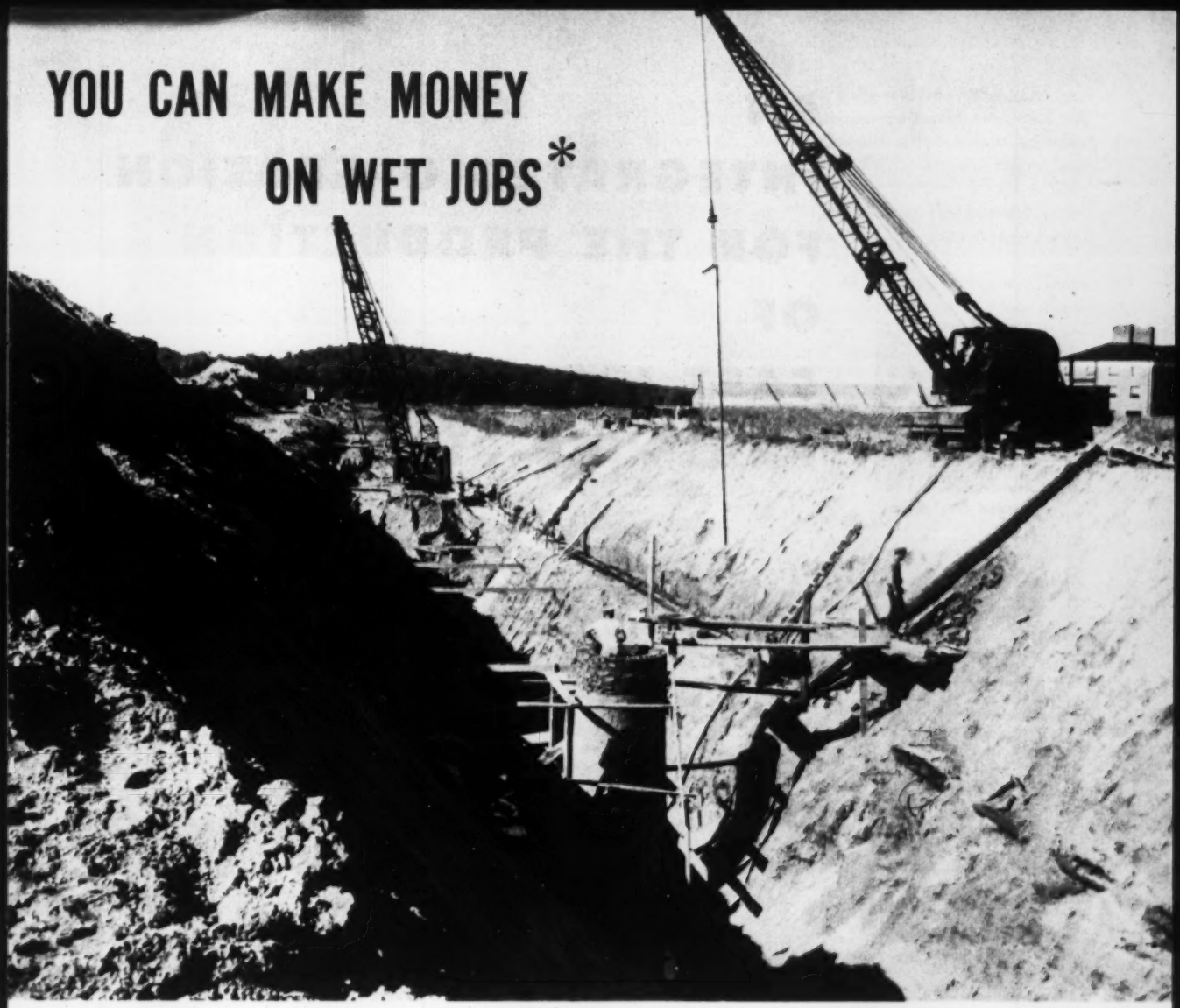

* IF YOU DIG THEM "In the Dry!"

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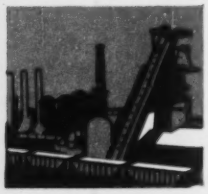

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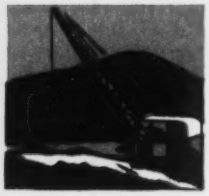

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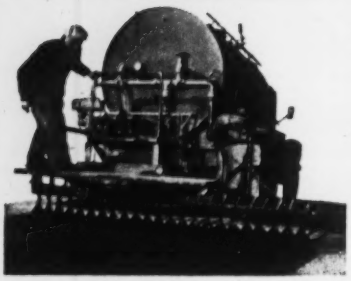

You will be interested in these facts obtained in our recent nation-wide survey:

- In the past five years most of the states in the union have *increased* the volume of sealing and surface treatment work done with asphalt emulsions.
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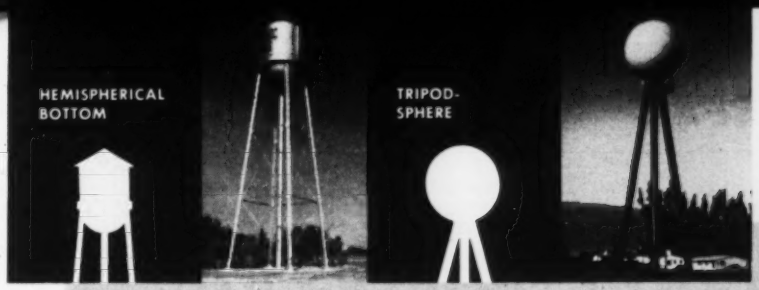

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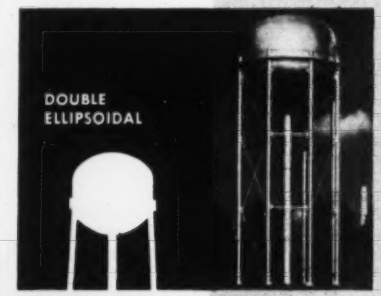

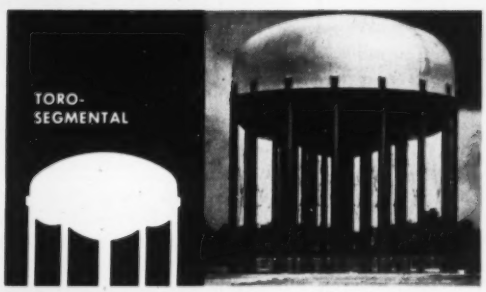

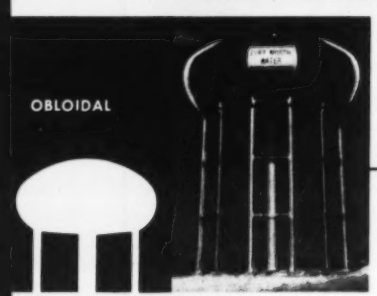

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600,000 CUBIC YARDS OF BLACK GUMBO

Contractor finds Kansas reservoir job a challenge to men and machines

Left to right, Lee V. Anspaugh, project engineer; George Preston, foreman, and James Murphy, superintendent, for Pohl.

PART of a $12,000,000 expansion program of Kansas Gas & Electric Co. is the construction of a reservoir on the Neosho River near Oswego, Kansas. The contract is being handled by Joseph L. Pohl, Nevada, Missouri.

The new excavation will add 50 acres to an existing reservoir on the site. When it is finished, the old reservoir will be dammed off, drained and deepened. Here water will be stored for doubling the power output of the Neosho plant and providing 66,000 added KW to meet the future needs of southeast Kansas.

The earthmoving is being done in sticky, water-soaked gumbo soil that makes a tough job even tougher. The slippery ground offers very poor traction, and the earth balls up in the scrapers and buckets and clings to the bulldozer blades.

Nevertheless, the Pohl organization has stayed on top of the job and expects to complete it on schedule in November. One of the principal factors in licking these bad conditions is the use of Caterpillar* equipment.

There are ten Cat* track-type Tractors working on the reservoir—two D8s and two D7s pulling Caterpillar-

Positive ejection forces this load of wet gumbo from the No. 70 Scraper, pulled by a Cat D7 Tractor.

built Scrapers; two more D8s and two D7s equipped with bulldozers; a D8 used as a pusher and a D4 pulling a sheepsfoot tamper. In addition, a Caterpillar No. 12 Motor Grader works on the haul roads, and a Lorain dragline with a 2-yard bucket is powered by a Cat D13000 Engine.

Superintendent James Murphy says: "Caterpillar-built machines stand up under rougher treatment, with less expense, than anything else we have run across."

On nearly any job where conditions are especially tough, contractors count on these rugged yellow machines to pull them through. They're built to take it. Your Caterpillar Dealer can supply you with ample evidence of low costs for down time and repairs, big daily production and long, profitable work life.

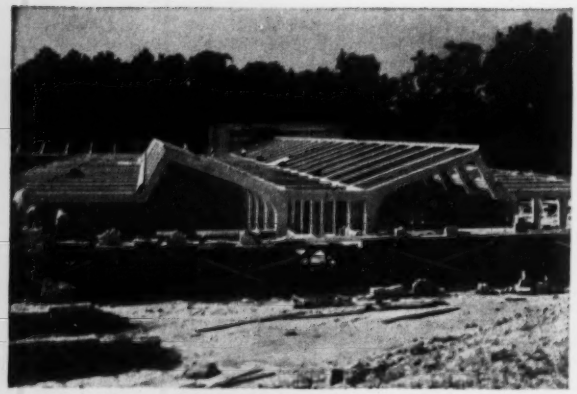
The sheepsfoot tamper shown here is pulled by a Caterpillar D4 Tractor. In the background, powered by a Cat D13000 Engine, is a Lorain dragline.

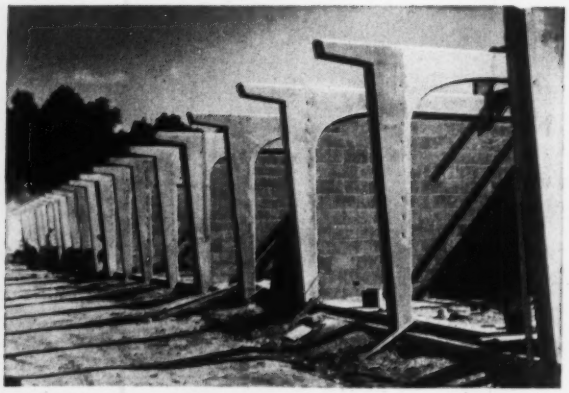
•

In spite of the sticky going, the D8 with No. 8S Bulldozer handles a big blade load.

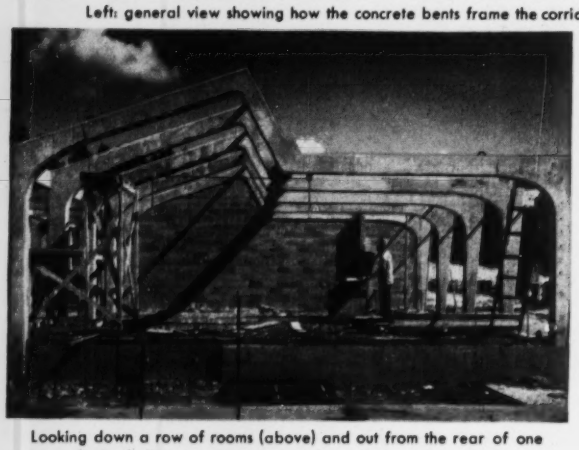
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

*Both Cat and Caterpillar are registered trademarks—®

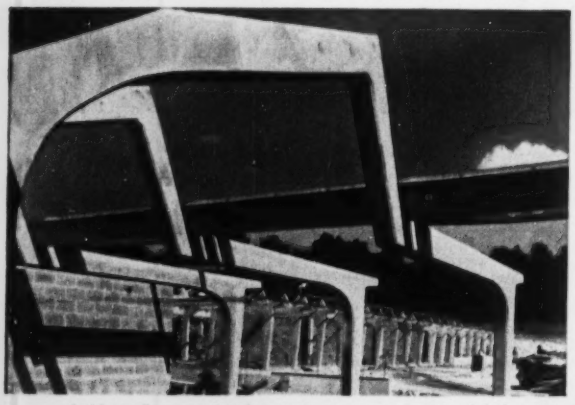




Left: general view showing how the concrete bents frame the corridor and two rows of classrooms. Right: closeup of one classroom wing.



Looking down a row of rooms (above) and out from the rear of one room (below). Bents were designed for inclusion of a skylight to equalize the light in inner areas of rooms farthest from windows.



New School Built at Low Cost with Precast Concrete Bents and Concrete Masonry Walls

You can design and build attractive schools at low cost with reinforced concrete frames and floors and concrete masonry walls. One example is illustrated in these construction photos. It is the Lindley Elementary School in Asheboro, N. C. John J. Croft of Asheboro was the architect and engineer. Dickerson, Inc. of Monroe, N. C. was the contractor.

One hundred fourteen precast concrete bents formed the entire frame of this school—in outside walls, inside hall and the roof with its skylight and overhang. The inner wythe of exterior walls and all partitions are exposed concrete masonry, painted. The entire building cost was only $9.58 per sq. ft.

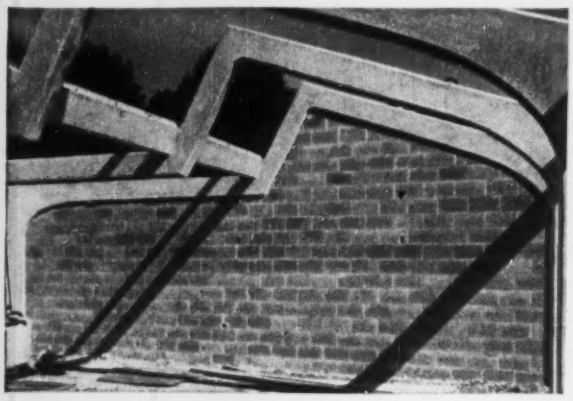
Besides low construction cost, schools such as this offer low maintenance cost and long life. That adds up to ***low annual cost.*** And they're firesafe. *Concrete can't burn!* For more information write for free literature. It is distributed only in the U.S. and Canada.

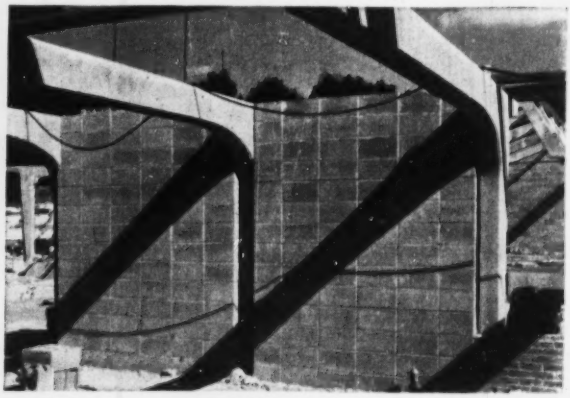
PORTLAND CEMENT ASSOCIATION

Dept. 7-13, 33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

Inside walls are painted concrete masonry, a running bond pattern for partitions and horizontal stacking for inner wythe of outside walls.





Illustrated above are two of the four Triple Reduction Type Herringbone Speed Reducers, specified by the United States Army Corps of Engineers, Portland, Oregon, and furnished to the Monarch Forge and Machine Works, to operate with precise control, four 42′ x 39′ Radial Control Gates at Big Cliff Dam located on the North Santiam River, Detroit, Oregon.

Its primary purpose will be to re-regulate the fluctuating discharges effected by the Detroit power plant. The water will be re-used to operate a power plant with an installed capacity of approximately 18,000 kilowatts.

Philadelphia Herringbone Gear Speed Reducers . . . meet all the requirements necessary for positive and economical transmission of power, with simplicity and high efficiency. The gears are arranged symmetrically with respect to the center line of the housing, producing equal loads on the bearings on each shaft, allowing a more compact design.

Write for Catalog H-49.

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Industrial Gears & Speed Reducers

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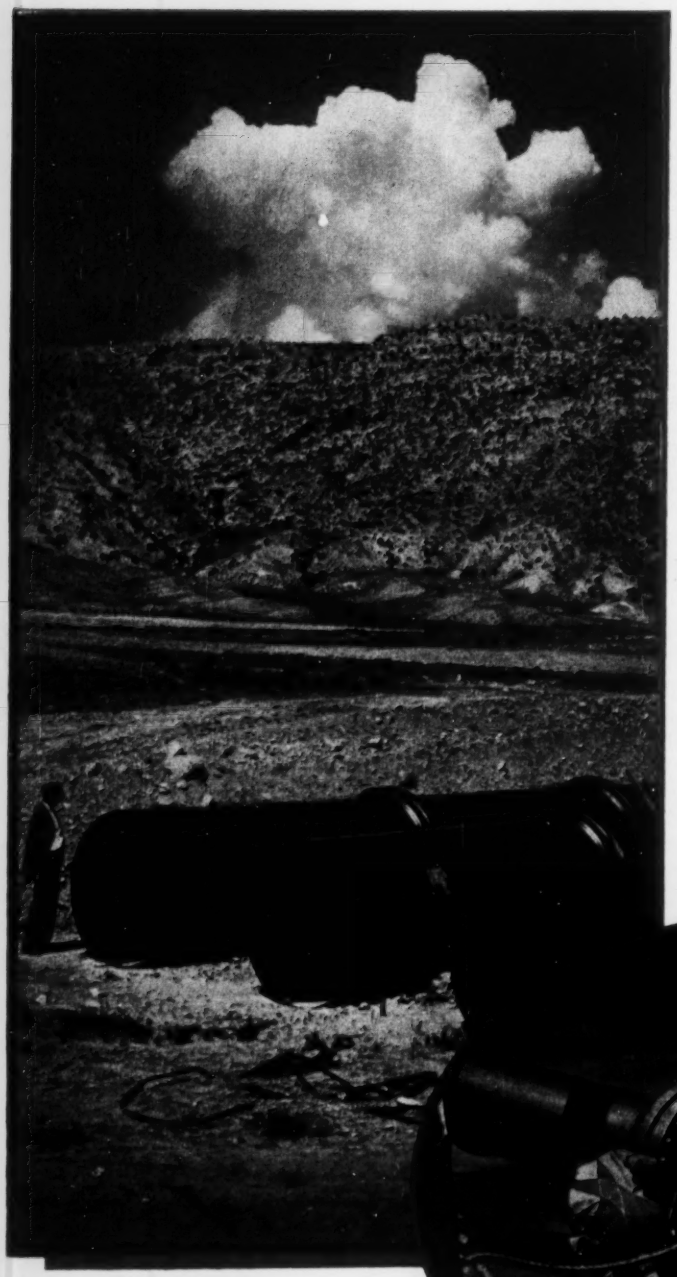
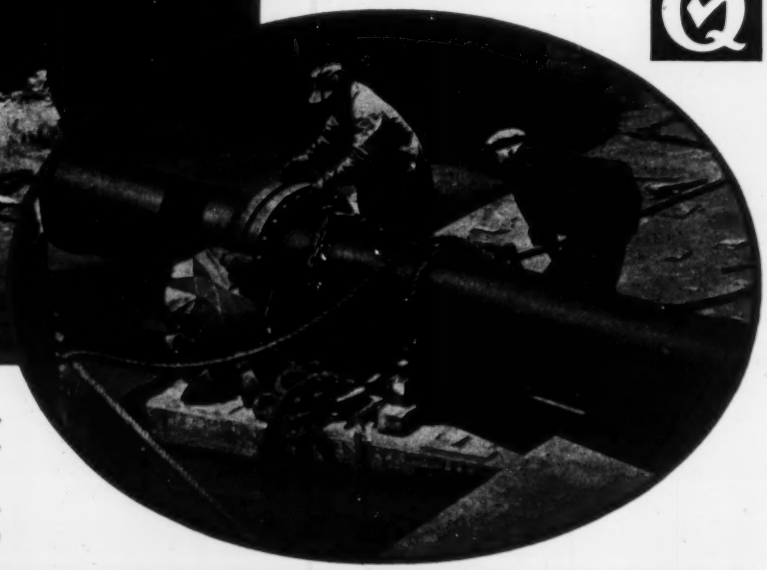


Versatile-

You know, of course, that cast iron pipe is widely used for water and gas mains, pressure sewers and outfalls, and almost exclusively in water filtration and sewage treatment plants. It is not so well known that this versatile pipe is also rendering yeoman service to Industry in keeping down maintenance cost in many applications. Such industries, for example, as chemical, paper, rayon and other process industries; coal mines and oil refineries; railroads and steel plants. Where effective resistance to corrosion is mandatory for long life and economy, specify cast iron pipe. For information write: Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

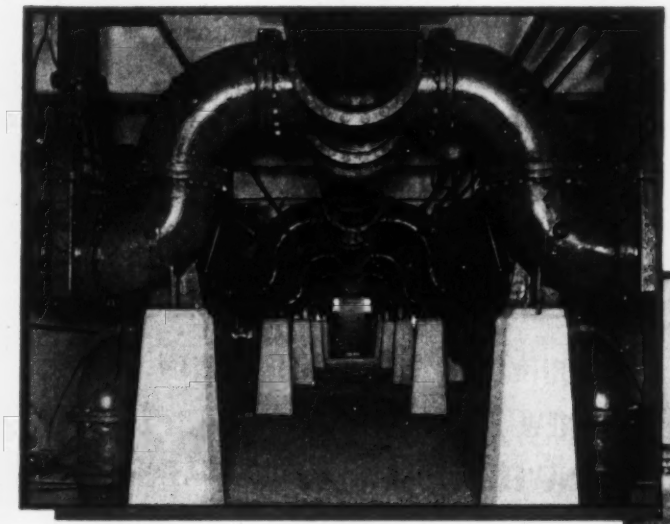


1800 feet of 36" to 60" cast iron pipe for culvert in connection with relocation of railroad tracks in Wyoming

(At right) A river-crossing cast iron water line near Chester, Pa., showing flexible joint assembly.

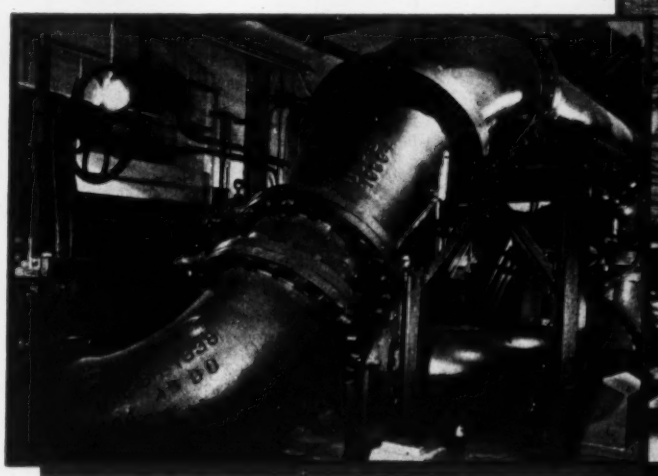
CAST IRON PIPE

is the word for CAST IRON PIPE



Submarine installation of cast iron flexible joint pipe for outfall sewer into Long Island Sound at Fairfield, Conn.

Cast iron pipe and fittings installed in gallery of water filtration plant in Muskegon, Michigan.



Installation of cast iron pipe and fittings in steam plant of a gas and electric utility in California.

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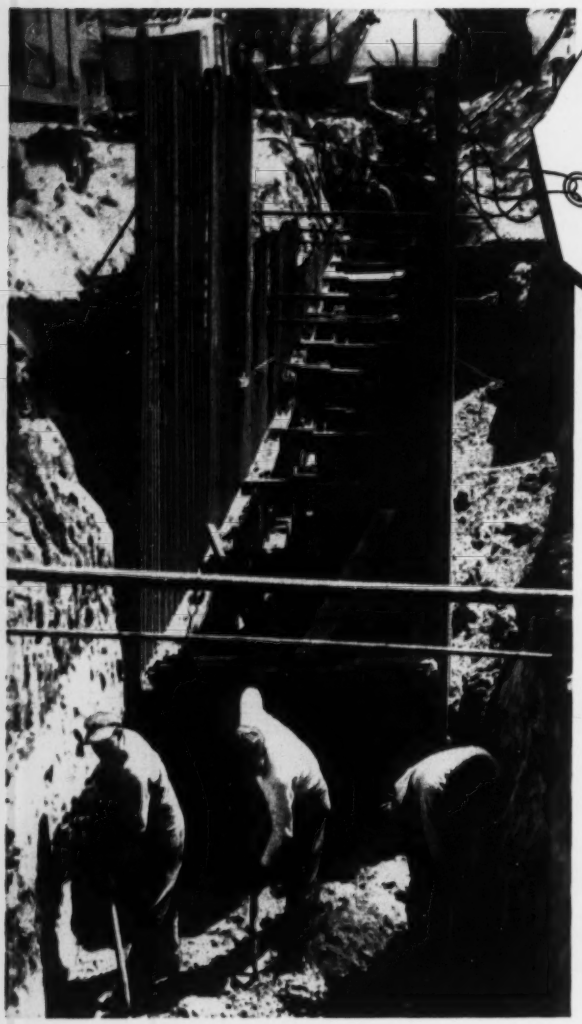
Greatest Strength POUND-FOR-POUND OF ALL LIGHTWEIGHT PILING



H-S HIGH-STRENGTH LIGHT-WEIGHT PILING

OUTMODES WOOD PILING WITH NEW EXCAVATION ECONOMIES NEVER BEFORE REALIZED

NOTE THESE SECTION MODULUS FIGURES:

Section	Gauge	Weight Lbs. Per Sq. Ft.	Section Modulus $In.^3$
LBF-1210	10	10.6	1.97
LBF-1510	10	8.6	1.14
LBF-1208	8	12.9	2.38
LBF-1508	8	10.5	1.36

Foster H-S (High-Strength) Lightweight Piling is the ideal sheeting for your next pipe trench, or your building excavations, shore and pier protections, and cofferdams. It offers exceptionally *high section modulus* from its exclusive "High-Strength" Box-type corrugations—the only piling to combine such high strength with all the advantages of light weight. Light enough to handle by hand—drive and pull it by hand too. And, unlike wood, you can use and re-use Foster H-S Piling indefinitely. As the photo shows, it requires minimum bracing, and its high section modulus gives a stiff section for exceptionally easy driving.

SAVE BY RENTING!

Rent all your Lightweight Piling needs on Foster's low-cost Rental Plan—get the exact length and section your job needs. Also all sections of Standard Heavy-Duty Steel-Sheet Piling available from L. B. Foster Co. warehouse or field stocks nearest you.

TWO IMPORTANT EXTRAS:

H-S Piling's new design Interlock permits simple folding together of two sheets for a watertight interlock. No longer necessary to slide one sheet into the other the entire length. Also permits hand handling or use of a rig with shorter boom. And . . . you can easily drive the regular straight sections in mild curves on circular jobs.

Send for Foster's H-S piling bulletin. It shows drawings of both 12" and 15" laying width sections and details of inside and outside corners. Write for bulletin CV-7.

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Water Wells • Vertical Turbine Pumps • Water Treatment

EIMCO

EIMCO TRACTOR-EXCAVATORS ON SLIM'S RIVER IN THE YUKON

Along the rocky shore line of Lake Kluane riprap is being loaded into big trucks by an Eimco 105. This is a race against time to beat the spring thaw.

The contract is for building a bridge and approaches to the Slim's River crossing on the Alaskan Highway which runs west from Whitehorse to the southern edge of Lake Kluane then northwest to Alaska.

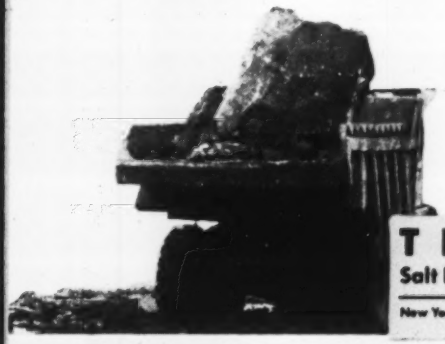
Working off the frozen surface of the lake in temperatures 30° to 45° below zero the Eimco 105 loads single pieces weighing 6 to 7 tons

into the trucks. Many times one rock will be a full load.

The huge pieces are used on the upstream side of the fill particularly near the bridge to protect the new fill from damage when the spring thaw starts breaking the ice in Slim's river and the flow starts toward the lake piling ice in against the fill.

Eimco 105 was selected for the loading job because of its easy operation and maneuverability. The 105 could also load large pieces that would have required much more expensive equipment. In addition the 105 could dig out the rock which usually freezes as soon as it falls to the ground after being blasted.

When your job requires fast, low-cost loading in rock, sand gravel or other material your best selection is the Eimco 105. Write for information.



Big trucks are loaded wtih chunks weighing 6 to 7 tons. Sometimes one rock is a load.

853

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Texas Birmingham, Ala. Duluth, Minn. Kellogg, Ida. London, Eng. Paris, France Milan, Italy

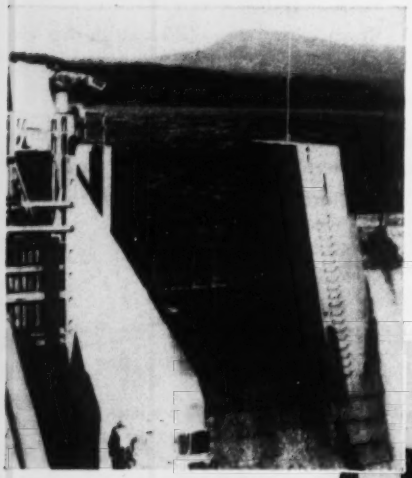
(Above) Trucks are spotted and quickly loaded by Eimco 105 Tractor-Excavators. No time is lost shifting from forward to reverse or between speed changes on the 105.

(Above) Eimcos are easy to spot to the truck because one track can be run forward while the other is run reverse.

(Below) Large pieces can be loaded from the side or end of the truck. The large granite rock in the bucket weighs between five and six tons.

(Below) Digging in broken rock is easy for the 105. This machine is designed for rock digging and loading.

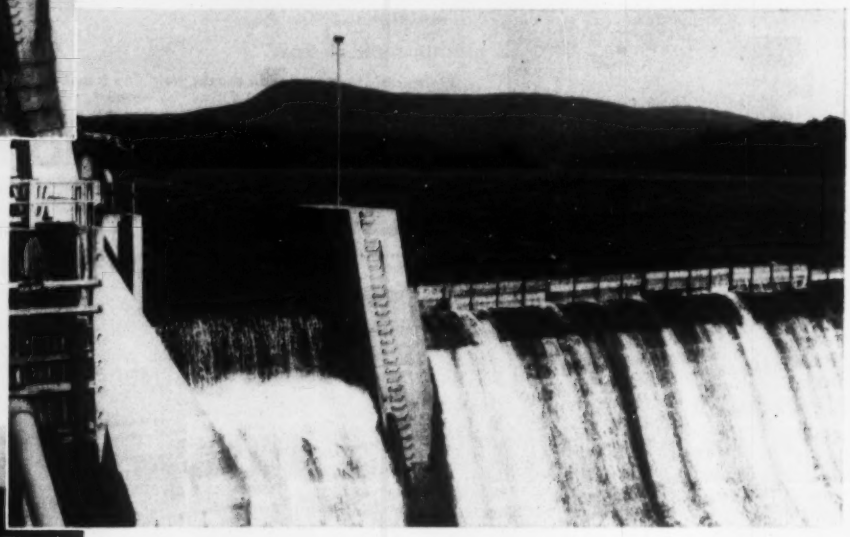
Bascule Crest Gates
by SMITH



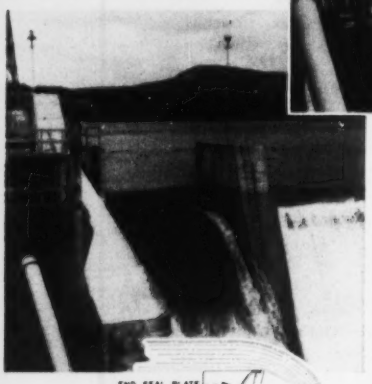
Left: This 8'-6" by 25'-0" SMITH-BASCULE GATE at the Holyoke Water Power Company on the Connecticut River is used principally for sluicing ice and debris away from the intake supplying a 22,000 HP SMITH-KAPLAN turbine. It also helps to prevent the loss of flashboards at times of moderate increases in river flow.

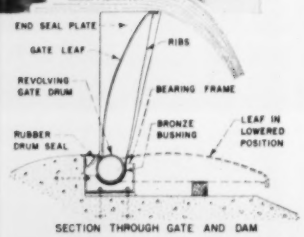
Above:
Gate in closed position.

Below: Gate nearly closed.



Below:
Gate in full open position.





SECTION THROUGH GATE AND DAM

SMITH-BASCULE GATES are hydraulically or electrically operated, with automatic or manual controls.

Available in sizes up to 10 feet in height by 100 feet in length, these gates permit the use of long, unobstructed spillways with controlled flow.

They are used for flood control, increased reservoir storage, and for sluicing.

Write for Bulletin No. 153.

POWER by SMITH — 16,000,000 HP

76 YEARS EXPERIENCE DESIGNING AND MANUFACTURING HYDRAULIC TURBINES AND ACCESSORY POWER PLANT AND PUMPING STATION EQUIPMENT

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Barber-Greene DITCHERS

DIG IN ANY SOIL . . .
ANY TIME OF YEAR . . .
FOR THE LOWEST COST PER FOOT OF TRENCH

Year-round utility makes B-G Ditchers favorites everywhere. Advanced features include the exclusive Vertical Boom that permits digging right up to walks, foundations, other obstructions, leaving no ramp . . . the milling action of the fast moving, closely spaced buckets that cut through coral, frozen ground, asphalt pavement . . . the overload release that slips when overload occurs, automatically re-sets itself.

ONLY B-G HAS THE

VERTICAL BOOM

BG Model 44-C

Heavy-duty, full crawler mounted. Cuts to 8'3" deep, 24" wide. Adjustable grade indicator. Follow-up scraper. Adjustable spoil conveyor discharges to either side. Replaceable digging teeth. Power boom hoist for instant control of Vertical Boom.

BG Runabout

Model 705B Service Ditcher. Combination of exclusive *Hydra-Crowd* and *Fluid Drive* transmission offers new operating advantages. New, curved, reversible insert teeth last 3 to 5 times longer. Pneumatic tired, travels at 15 m.p.h. One-man operation.

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NEWS OF ENGINEERS

W. W. DeBerard, Honorary Member of ASCE and deputy commissioner for water and chief water engineer in the Chicago Department of Water & Sewers, was recently voted the George Warren Fuller Award for 1954 by the American Water Works Association. The award is presented annually for outstanding contribution to the advance of water works practice and design.

Henry L. Doten, business manager of the University of Maine and former member of the Maine State Highway Commission, has been installed as president of the National Association of Educational Buyers.

Conrad P. Straub, senior sanitary engineer at the Environmental Health Center of the U.S. Public Health Service at Oak Ridge, received the annual Fuertes Alumni Medal of Cornell's School of Civil Engineering at the C.E. Alumni Breakfast on June 12. The award is for papers on "Radioactive Waste" presented at the Eighth Industrial Waste Conference at Purdue University in 1953. Dr. Straub is chairman of the Sanitary Engineering Division's Committee on Sanitary Engineering Aspects of Nuclear Energy.

Raleigh W. Gamble, for the past 30 years superintendent of the Bureau of Street Construction and Repairs for the City of Milwaukee, and for four years director of expressways, recently retired from municipal service. He is now associated with the Asphalt Institute in Chicago.

Edgar G. Plautz, former expressway engineer for the Wisconsin State Highway Commission, is now serving as a division engineer in the newly created Milwaukee Metropolitan Division.

Richard J. Gayer, for the past two years assistant director of public works for the City of Bangor, Me., was recently named first public works engineer for Brunswick, Me. He has also accepted the position of engineer for the Brunswick Sewer District.

Fred N. Magrath received the master of science degree in civil engineering from Columbia University during the current commencement season. Mr. Magrath is employed as a civil engineer with the Arthur A. Johnson Corp., of New York.

Sydney Wilmot (left), retired manager of ASCE Technical Publications, receives the Brown Bear award from Elmer S. Horton, president of the Brown Alumni Association, during an alumni dinner at Brown University in Providence, R.I. Mr. Wilmot, a member of the class of 1909, was cited for his service to the university "as an adviser and counselor to engineers and for his work in founding the Brown Engineering Association." He was one of three recipients of the award, Brown's highest alumni award.

Is this a record?
We think so!

One of Fairchild's high-flying photo crews on foreign assignment, taking full advantage of an unusual break in the weather, turned in an outstanding performance of 7609 square miles of aerial photography in one day—*an area exceeding that of the entire states of Connecticut and Delaware!*

But speed is only a part of the Fairchild story. First civilian organization to perform ultra-high altitude aerial photography, Fairchild's 34 years of experience assures a sound engineering approach to your problems, on-time performance, and a completed workmanlike job.

For your next aerial survey problem—water power, irrigation, highway, railroad, pipeline location, geologic studies, airborne magnetometer mapping *call Fairchild.*

Mapping programs during 1954 in eleven countries on four continents

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Myron Hendee, chief land planning consultant to the Federal Housing Administration, with headquarters in New York, N.Y., has been transferred to the District of Columbia Redevelopment Land Agency, Washington, D.C.

James R. Villemonte and **Gerard A. Rohlich,** professors of civil engineering at the University of Wisconsin, were among 16 engineers from American colleges and universities, selected to work in India under the Foreign Operations Administration, for the 1954–1955 academic year. Professor Villemonte has been assigned as a specialist in hydraulic engineering to the Bengal Engineering College of Sibpur, West Bengal, and Professor Rohlich as a specialist in municipal engineering to Roorkee University at Roorkee.

Theodore Briganti has resigned as chief of the sanitary engineering section of Knappen - Tippetts - Abbett - McCarthy to enter into partnership with **Domenico Crachi, Jr.,** Civil Engineer. They will act as consultants on all types of municipal work and land surveying, with headquarters at 406 Maple Avenue, Westbury, L.I. **Harold W. Blake** has temporarily assumed Mr. Briganti's duties at Knappen-Tippetts-Abbett-McCarthy.

A M Rawn, chief engineer and general manager of the Los Angeles County Sanitation Districts, **Charles G. Hyde,** consulting sanitary and hydraulic engineer of Berkeley, Calif., and **David H. Caldwell,** partner in the San Francisco engineering firm of Brown & Caldwell, are serving as consultants on a $25,000,000 sewage collection and treatment program for the city of Auckland, N.Z.

William C. Renshaw was recently named to the post of chief engineer and general manager of the Las Vegas Water District. The former water engineer and superintendent of the water department of Inglewood, Calif., has had long experience in the San Francisco Water Department.

Henry G. Kuyl retired on April 30 as chief engineer of the Board of Engineers for Rivers and Harbors, Department of the Army, with headquarters in Washington, D.C. Mr. Kuyl's work with the department began in 1926, when he was employed by the District Engineer, Chattanooga, Tenn., as hydroelectric engineer on the comprehensive survey for improvement of the Tennessee River for power navigation, and flood control. In 1929 he transferred to the Board and became chief engineer in 1942.

George M. Shepard, chief engineer of the St. Paul (Minn.) Department of

(*Continued on page 26*)

THIS PIPE GIVES EXTRA HANDS TO CONTRACTORS

Lines of large diameter Naylor pipe are just like extra hands in the construction field. They carry air. They carry water. They do a whale of a job on ventilating in tunnel work and other underground construction. Light weight makes Naylor lines easy to handle and install. The extra strength of the lockseamed-spiral-welded structure adds what it takes for these lines to stand up in rough service. The Naylor Wedge-Lock coupling simplifies connection and speeds construction right down the line. Diameters from 4″ to 30″ and wall thicknesses from 14 to 7 gauge provide size range to meet all requirements. Write for Bulletins No. 507 and No. 513.

NAYLOR PIPE

Naylor Pipe Company • 1281 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

News of Engineers

(*Continued from page 25*)

Public Works, and a city employee for 30 years, was honored for outstanding public service at a recent testimonial dinner. He was presented with a $3,000 check, which he and Mrs. Shepard will use for a trip to Europe, where they will visit the graves of their two sons killed in World War II.

Philip R. Garges, district engineer for the Corps of Engineers at Buffalo, N.Y., has accepted an appointment as staff engineer at The Citadel, Military College of South Carolina. Colonel Garges will assume his new post early in August.

Michael Baker, Jr., president of the consulting engineering firm of Michael Baker, Jr., Inc., Rochester, Pa., has been appointed to the Pennsylvania State Board for the Registration of Professional Engineers.

Claude H. Chorpening has been promoted from the rank of brigadier general to major general in the Corps of Engineers. General Chorpening has just completed a tour of duty in Washington, D.C., as assistant chief of engineers for civil works, and is now on assignment in Tokyo.

Frank T. Clarke was recently appointed manager of sales for the Boston office of the American Steel & Wire Division of the United States Steel Corp. Affiliated with American Steel & Wire since 1921, Mr. Clarke was manager of manufacturers' products in New York at the time of his promotion.

Blair I. Burnson has been promoted from supervising sanitary engineer to executive assistant to the general manager of the East Bay Municipal Utility District, Oakland, Calif. He has been supervising sanitary engineer since 1945.

Benson J. Wood, formerly chief structural engineer for the Detroit engineering firm, Harley, Ellington and Day, Inc., has been named to the newly created post of production manager. His assistant, **Joseph C. Watts,** has succeeded him as chief structural engineer. A third promotion is that of **Peter Sfat,** senior structural engineer, who fills Mr. Watts' former position as assistant chief structural engineer.

John H. Carruth, colonel, U. S. Army (retired), has joined the staff of V.L. Beavers and Associates, Consulting Engineers, of San Antonio, Tex. Colonel Carruth, a former officer in the Corps of Engineers, has been acting as principal of the Armed Services Preparatory School at San Antonio. He was recently elected a second vice-president of the Society of American Military Engineers.

James H. Childs, of Auburn, Ala., and **Thomas F. Hobart,** of Birmingham, Ala., have been elected honor members of the Chi Epsilon chapter at Alabama Polytechnic Institute, their alma mater. Mr. Childs, in retirement for several years, was formerly with the U.S.B.R. Mr. Hobart is vice-president and general manager of the Southern Amiesite Asphalt Co.

Stephen D. Bechtel, president of the Bechtel Corp., of San Francisco, Calif., has been elected a director of J. P. Morgan & Co., Inc.

ASCE Members Win Honorary Degrees

The current commencement season has brought honorary degrees to a number of Society members. Recipients include **Henry T. Heald,** chancellor of New York University, the degree of doctor of laws from Columbia University; **G. G. Meyerhof,** senior technical assistant, Foundation Co., of Canada, Montreal, the degree of doctor of science from the University of London; **David B. Steinman,** New York consultant, the degrees of doctor of engineering from Michigan College of Mining and Technology, and doctor of civil engineering from the University of Bologna; and **Victor Emil Vallet,** president of Giffels & Vallet, Inc., Detroit, Mich., the degree of doctor of engineering, University of Colorado.

no problem with water pressure in Newark!

Since 1934, by using cement lining in its trunk mains, Newark's water flow has been boosted from 57 to 83 million gallons a day.

This was made possible by converting old pipes into new—free of tuberculation and interior corrosion. Here's how it was done: old pipes were hydraulically cleaned, centrifugally machine-lined with mortar cement and smoothed to an even surface. The result: distribution pressure and carrying capacity greatly increased, maintenance costs substantially lowered and life expectancy of pipes extended indefinitely. Entire process done with pipes in place at a *fraction* of the cost of laying new pipes.

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3,000,000 FEET OF EXPERIENCE

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CEMENT-MORTAR LINING OF PIPES IN PLACE

Robert L. Lewis, A.M. ASCE, dean of the College of Engineering and director of the Technical School at Addis Ababa, Ethiopia (center), converses with Haile Selassie I, Emperor of Ethiopia (on his left) and Akalawork Haptewold, Ethiopian Vice-Minister of Education, at recent dedication ceremonies of the College of Engineering. Dean Lewis, who has been in Ethiopia since 1951, will return to his home at Fort Collins, Colo., this summer for a holiday. He has been engaged in a $250,000 building program at the college, which will enable the establishment of a four-year civil and mechanical engineering curriculum.

John A. Neale was reelected president of the Society of Fire Protection Engineers at the society's May 20 annual meeting at the Hotel Statler, Washington, D.C. Mr. Neale is the chief engineer of the National Board of Fire Underwriters, New York, N.Y.

Morton O. Withey, former dean of the School of Engineering at the University of Wisconsin, was recently elected to honorary membership in the American Institute of Architects. He received a certificate at the Honor Awards Luncheon, held during the institute's annual meeting in Boston this past June.

Albert E. Cummings, director of research for the Raymond Concrete Pile Co., New York, N.Y., is one of five new appointees to the advisory committee of the research division of New York University's College of Engineering.

Charles E. Davis was honored by the Associated Engineers of Spokane at a luncheon at the Davenport Hotel, on May 19, on the occasion of his retirement as city engineer. **Benjamin Garnett,** bridge engineer and since 1952 assistant to Mr. Davis, succeeds him as city engineer.

Carlyle G. Burland recently became project manager for the Boston engineering firm, Lockwood Greene Engineers, Inc.,

(*Continued on page 29*)

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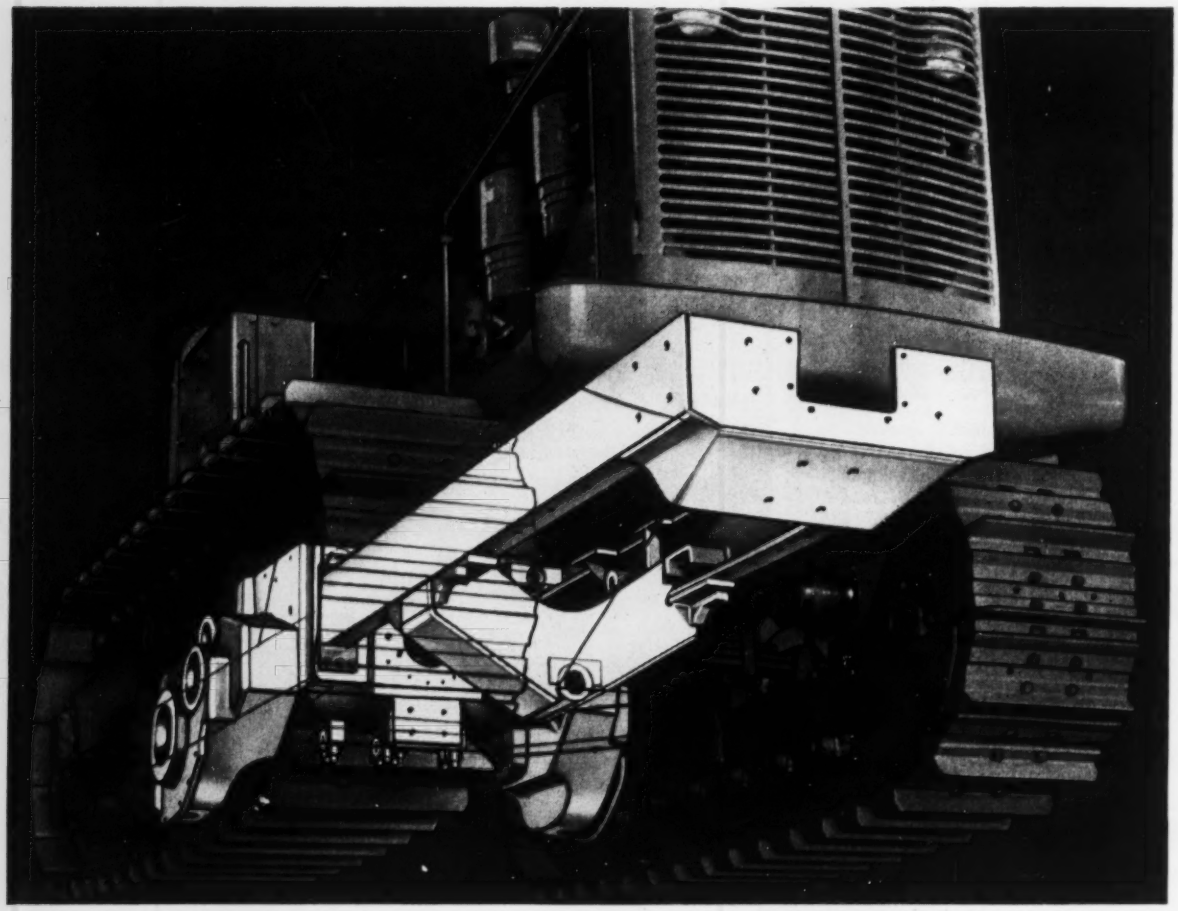

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Fig. B-144-A

One of Two 48" Type M Gates installed in Ft. Stanton Park Reservoir, Washington, D. C., to maintain direction of flow. See Feb. 22, 1944, issue Engineering News Record for story about this project.

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News of Engineers

(*Continued from page 27*)

after 31 years of service with the Massachusetts Department of Public Works. Fellow engineers in the Department of Public Works honored Mr. Burland with a banquet and life membership in the Massachusetts State Engineers Association.

George F. Baker disclosed that he will retire on June 30, 1955, from his post as city service director for Dayton, Ohio, after more than 32 years of municipal service.

Peter Corradi, commander, U.S. Navy, has been assigned as district public works officer, to the Sixth Naval District Headquarters, Naval Base, Charleston, S.C. He was formerly deputy to the assistant chief for operations in the Bureau of Yards and Docks, Washington, D.C. Commander Corradi entered the Naval service in December 1940 as a lieutenant in the Civil Engineer Corps.

Peter Corradi

H. T. Person, dean of the College of Engineering at the University of Wyoming, recently received an engraved desk set from the faculty at a celebration honoring him for 25 years of service—longest in the history of the university.

James K. Pickard opened a consulting practice in atomic energy developments following his resignation from the U.S. Atomic Energy Commission in May. He has set up an office in Washington, D.C., (1518 K Street, N.W.) as successor to **Frederick H. Warren** who recently became connected with the General Dynamics Corp. Mr. Pickard has been engaged in atomic energy activities continuously since 1944 for the Manhattan Engineering District, the AEC, and contractors of both government agencies.

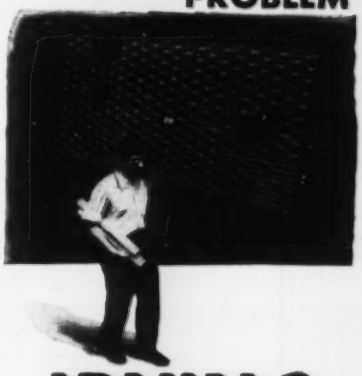
Reginald C. Price, on a two-year leave from the Federal Power Commission, has joined the UN Economic Commission for Asia and the Far East, at Bangkok. His work will include the planning and economic analysis of water projects in the region, including flood control, irrigation, and hydroelectric power developments, and soil erosion control. Until recently Mr. Price was assistant to the chairman of the Federal Power Commission.

Elbert M. Prince was recently elected town manager of Skowhagen, Me. He formerly was at Vassalboro, Mass., in the same capacity.

(*Continued on page 103*)

ENGINEER ... WITH

WEIGHTY PROBLEM



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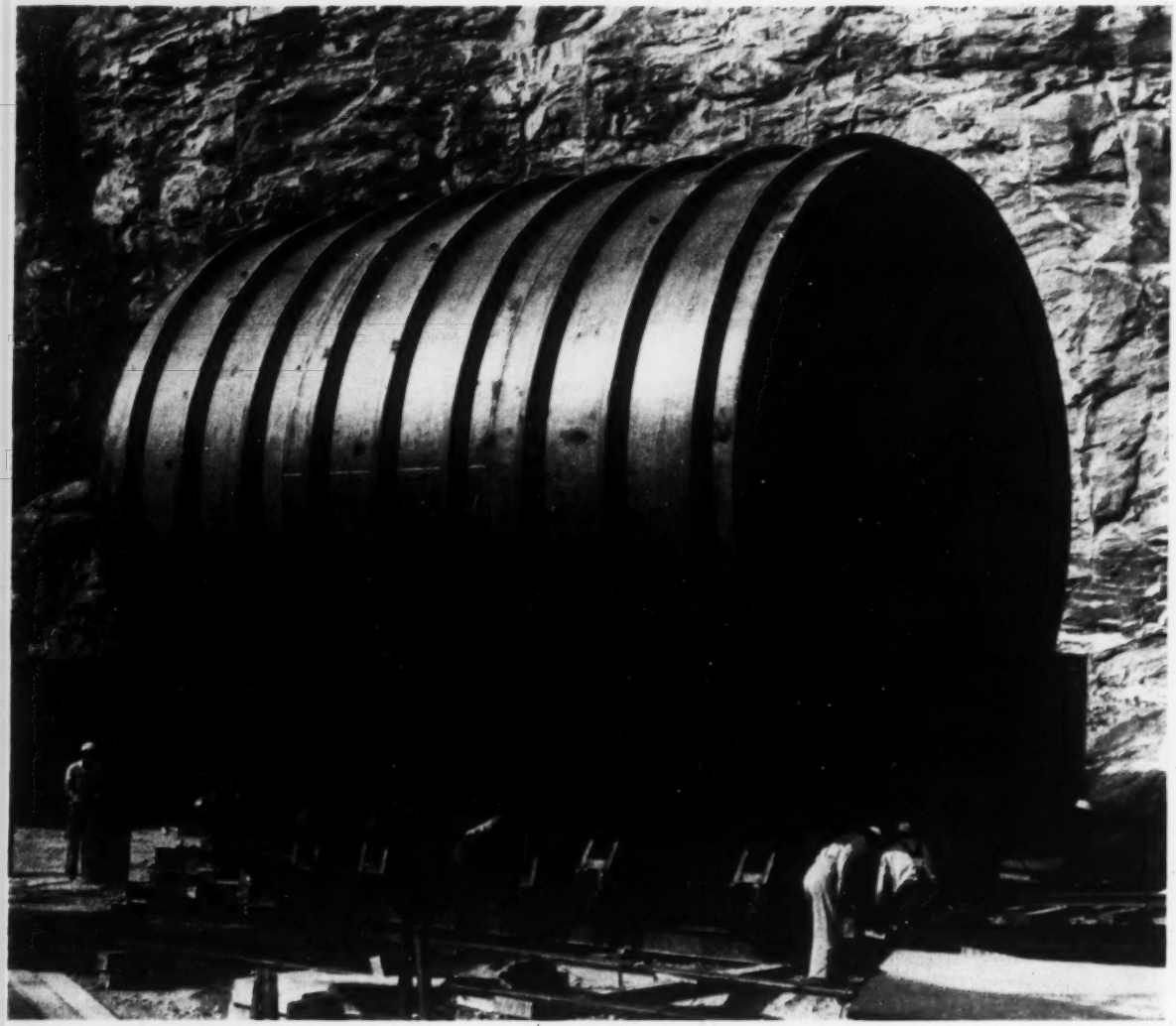

Horton Penstocks at Buford Dam Project

A key project for control of the Apalachicola River system, Buford Dam is a 200-ft. high by 1,630-ft. long earth fill structure now under construction on the Chatahoochee River 35 miles northeast of Atlanta, Georgia. The development is being carried out by the U.S. Army Corps of Engineers.

To meet the penstock requirements at Buford Dam, the Chicago Bridge & Iron Company supplied three penstock linings, two 22-ft. diameter by 216-ft. long and one 10-ft. diameter by 122-ft. long. The penstocks were fabricated at our Birmingham plant, shipped to the site and assembled in 27-ft. sections in the dams tail race area. All longitudinal seams and girth seams for the 27-ft. sections were welded with an automatic welding machine while the stiffener angles and tunnel girth seams were manually welded.

During the past 64 years, Chicago Bridge & Iron Company has been called upon to solve many complicated and unusual steel plate problems. Not only penstocks but such diversified structures as tunnel forms; floating covers for sewage plants; floating roof tanks, refinery towers, spherical and spheroidal tanks for the petroleum, chemical and other industries; elevated water tanks, standpipes and reservoirs for plant and municipal water systems.

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The dues increase has gone through? In the recent balloting, in which 16,555 members voted, the ballot for amendment of the Constitution to provide for the dues increase was carried by 1,009 votes. The Tellers' Report is on page 67.

Who the next President of ASCE is likely to be? William R. Glidden, assistant chief engineer of the Virginia Department of Highways and a former Director and Vice-President, is the official nominee for President in 1955.

A satisfactory plan for increasing Panama Canal capacity is still lacking? A fifteen-engineer report of the Panama Canal problem, which condemns the proposed Sea-Level Project and recommends a Board study, is on page 58.

There is only one engineer on the St. Lawrence River Joint Board of Engineers? EJC has protested the non-engineering nature of the recently formed St. Lawrence River Joint Board of Engineers and urges appointment of engineers to the Advisory Board that will soon be set up for development of the project (page 68).

Winners of ASCE Prizes and Awards for 1953 have been announced? Actions of the Board of Direction at its recent Atlantic City meeting included the award of prizes for papers in Volume 118 and in the Centennial Volume of TRANSACTIONS (page 66).

The nation is to have its first central station atomic power plant? Pittsburgh will be the site of the huge plant—a joint project soon to be built by the U.S. Atomic Energy Commission and the Duquesne Light Company (page 77).

Delivery of Labrador's first iron ore has been made? The first trainload of 60 cars of Knob Lake ore arrived in the Port of Seven Islands on the St. Lawrence River on June 23. The ore was carried on a newly completed 365-mile railroad through the Labrador wilderness (June 1952 issue, page 42, for details).

The new "Who's Who in Engineering" is out? The new (seventh) edition, which was issued this spring, contains over 20 percent more biographical data than the previous edition. It sells for $17.50 and is available from the Lewis Historical Publishing Co., 265 West 14th Street, New York City 11 (May issue, page 90).

You can keep abreast of current atomic energy developments? Read "Nuclear Science Abstracts," published by the AEC and providing news of all the latest non-classified reports of the AEC plus pertinent material from open-file literature, both foreign and domestic.

Valuable fuel can be saved by coal-recovery plants? A new $6,000,000 plant, built by the Pennsylvania Water & Power Co. at Safe Harbor, Pa., will reclaim over 500,000 tons of anthracite coal annually from the bed of the Susquehanna River. The plant is described by two company engineers on page 34.

You may be forced to join a union? The experiences of a Junior Member will be of interest to engineers who think they can afford to be indifferent to collective bargaining (page 51).

Part of the New York Thruway is open to traffic? A 115-mile section of the Thruway (between Rome and Scottsville, N.Y.) was officially opened on June 24. The 70-mile link westward to Buffalo will open in the late summer, and the 212-mile stretch between Rome and Suffern, N.Y., by December.

You can still get the 1954 Directory of Membership? If you are a member and forgot to ask for your copy of the 1954 Directory of Membership, a postal card request to Society headquarters will do the trick.

A new record in skyscraper construction was established this June? A building operation that would normally take from eight to ten weeks was accomplished in less than ten hours on June 21, when aluminum facing for two sides of a 22-story New York office building was placed by six crews of six men each. Details and before-and-after photos on page 80.

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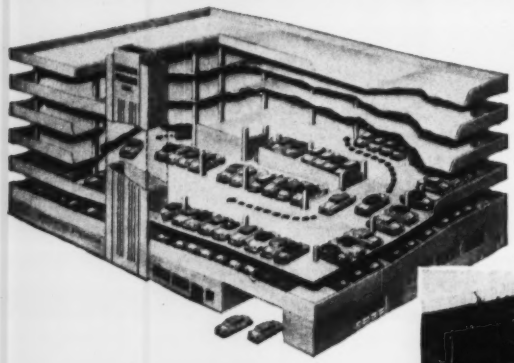

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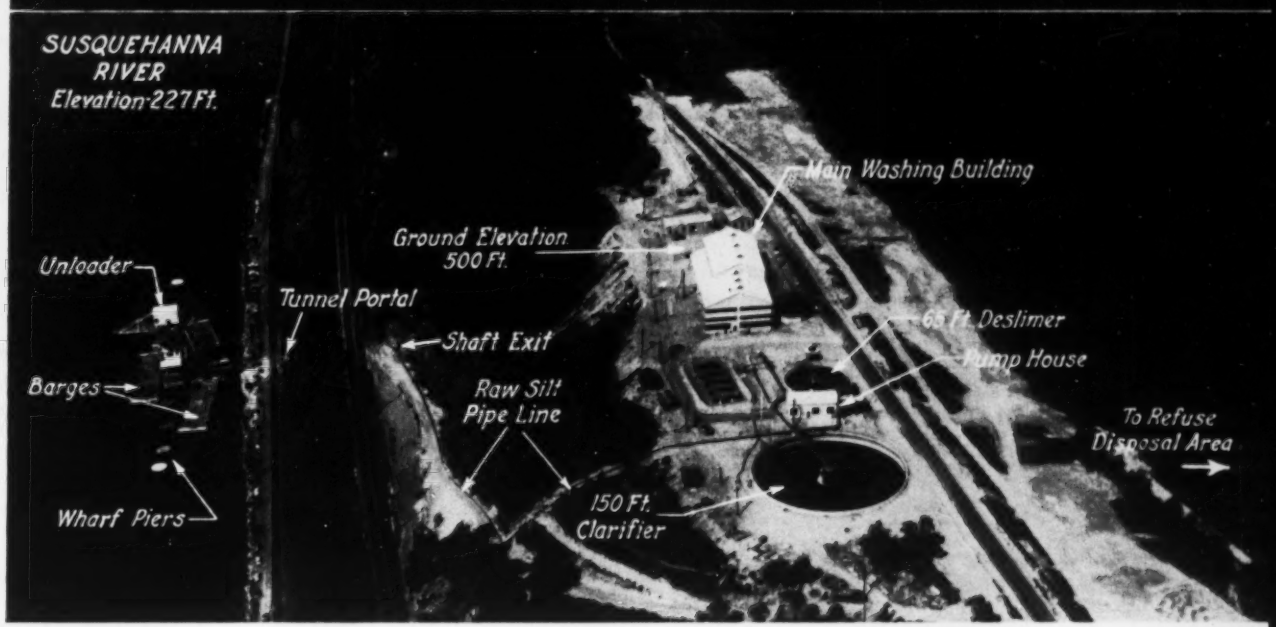


Main coal reclaiming plant, seen from air, is located about 275 ft above river level. Structures are substantial, of steel and concrete with corrugated asbestos siding. All shore units of plant are interconnected by public address system as well as by telephones.

Six-million-dollar plant recovers fine coal from Susquehanna River

PAUL LEVIN, Senior Engineer

D. I. SMITH, Assistant Chief Engineer, Construction

Pennsylvania Water and Power Company, Baltimore, Md.

Although many miles distant from the nearest anthracite coal fields, the new and modern plant of the Pennsylvania Water & Power Company at Safe Harbor, Pa., will reclaim over 500,000 tons of anthracite coal annually from the bed of the Susquehanna River. In the early days of coal mining, this fine "river coal" was dumped directly into creeks and streams after the desirable coarse coal had been extracted. In later years, fine coal was often accumulated near the breakers in huge banks, from which erosion carries large quantities into nearby waterways.

Since the Susquehanna River drains approximately 80 percent of the Pennsylvania anthracite fields, the natural migration of the fine coal downstream delivers huge quantities to the reservoirs of the two hydroelectric plants on the river not far above the Maryland-Pennsylvania line at Holtwood and Safe Harbor, Pa. Holtwood Dam, which forms the lower reservoir, was built in 1910, and the Safe Harbor Dam, 8 miles upstream, which forms the upper reservoir, was constructed in 1931. The fine-coal deposits, usually considered a hindrance to hydro plant operators, attracted the attention of the company as a possible

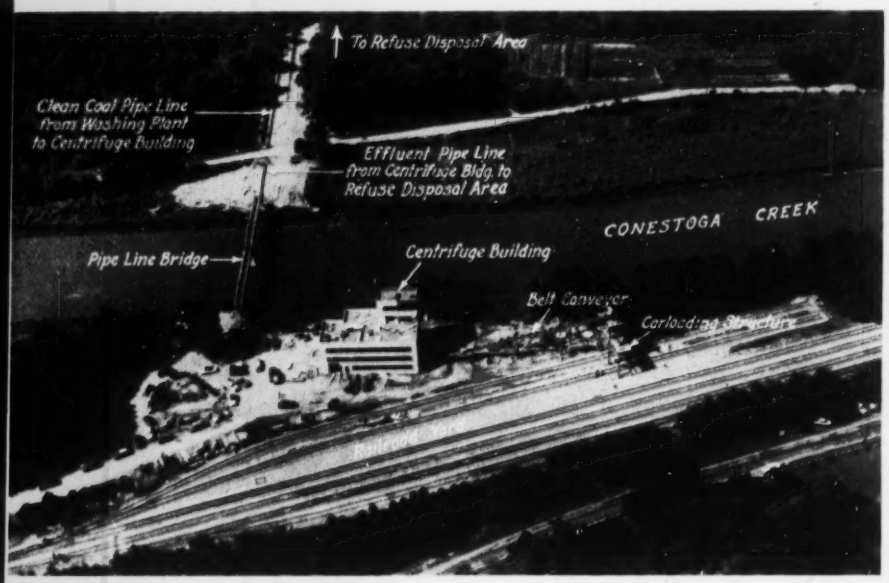
source of fuel as early as 1919. In 1925 a pulverized coal-burning steam station of 30,000-kw capacity was built at Holtwood adjacent to the hydro plant. Originally designed for anthracite fuel, but started on bituminous, the plant soon began burning increasing quantities of river coal recovered from the Holtwood pond by outside contractors. In 1934, the company constructed its own coal recovery plant, and since 1938 the Holtwood Steam Station has been using river coal as its sole fuel. In the 20 years since 1934, the company has recovered over 3,000,000 tons of river coal, in recent years at a rate averaging more than 200,000 tons annually.

At the outset the coal was produced on the river by wet screening the dredged material, reclaiming only the coarser particles, and discarding back to the river the finer coal together with the sand and mud. As a result of an extensive research program, the company developed efficient means of recovering the coal over a wide range of sizes including the 200-mesh size. In 1939, the company constructed a pilot plant which used successfully a combination of vibrating sizing screens, shaker tables, and froth flotation cells. The pilot plant, later placed in commercial operation, was one of the first to use the froth flotation process for fine-coal recovery.

A new study was started in 1947 when it became evident that the company's system would need additional power capacity. This study showed that if the existing steam station at Holtwood were more than tripled in capacity by the addition of a 66,000-kw steam generator, river coal could be secured at a cost per million Btu appreciably less than that of competing fuels. It was determined by a series of carefully planned and executed surveys that coal was still accumulating in the dredgeable deposits of the Safe Harbor pool at a very substantial rate, such that a coal plant of the size contemplated would have a source of supply for approximately 35 years.

Results of studies

It was therefore decided to proceed with the new coal-recovery project at a capital cost of about $6,000,000 and during 1951 the first contract was let. The flow sheet of the new plant followed substantially that of the old plant operated by the company at Holtwood, although some new features proved by experimental work were incorporated. Because by far the largest deposits of coal lie behind the Safe Harbor Dam, and because


To Refuse Disposal Area
Clean Coal Pipe Line from Washing Plant to Centrifuge Building
Effluent Pipe Line from Centrifuge Bldg. to Refuse Disposal Area
CONESTOGA CREEK
Pipe Line Bridge
Centrifuge Building
Belt Conveyor
Carloading Structure
Railroad Yard

Dewatering of reclaimed coal takes place in centrifuge building, near car-loader at railroad yard. All-welded steel-truss bridge 200 ft long not only carries pipeline delivering reclaimed coal in suspension to dewatering plant but also line taking effluent back to refuse basin. Plant conforms with all provisions of Pennsylvania's clean streams program, which requires disposal on shore of all waste removed from the river.

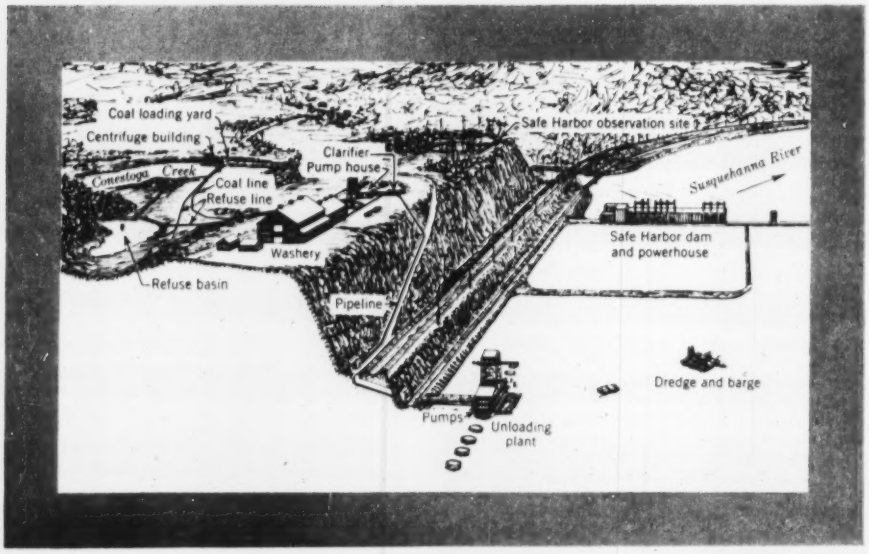


FIG. 1. New coal recovery plant of Pennsylvania Water & Power Co. is located on Susquehanna River just upstream of Safe Harbor Dam. Shore installation consists of three main parts: barge unloader near shore, washing plant on bluff, and dryer and rail loader on far bank of Conestoga Creek.

most of the inflow of coal moving downriver will be trapped there, the coal plant was located at Safe Harbor just above the hydroelectric plant, the finished product being transported by rail 8 miles to the steam station at Holtwood for immediate use or for storage. The recovery plant is designed for an annual capacity of 570,000 net tons of coal with an ash content of 16 percent and moisture content of 18 percent, giving a heat value of 10,000 Btu per lb. Operation will be on a 24-hour-per-day basis during the 9-month operating year. During the 3-month winter shutdown due to ice conditions, the steam plant at Holtwood is kept in service by a storage pile with a peak capacity of 200,000 net tons.

The coal-bearing silt as it lies on the river bed shows extreme variations, so that the equipment had to be selected to deliver the desired tonnage even when handling fine silt of low quality. The cleaned coal ranges in size from a maximum coarseness of about 10 mesh (1/16 in.) to a minimum size of approximately 200 mesh (0.003 in.). Every effort is made to remove the minus 200-mesh coal, first, because of the difficulty involved in cleaning it, and second, because of the stickiness which it imparts to the finished coal, making handling difficult. From the dredged material loaded in barges, a recovery of 75 to 80 percent of the combustible matter is expected.

In the first operation of the recovery process, a 14-in. hydraulic rotary cutter dredge, direct driven by a 350-hp diesel engine, deposits the silt from the river bottom in two 800-ton steel barges simultaneously, one barge tied to each side of the dredge. The dredge was designed for this simultaneous loading of two barges to obtain a low overflow velocity in the barges and thus reduce the loss of coal over the end weirs of the barges. A fleet of four 800-ton and two 700-ton barges allows the dredge to operate continuously. The dredge, built by Ellicott Machine Corporation, is designed to dig to a depth of 45 ft.

Unloader location a problem

The location and design of the unloader and wharf posed a major problem which was solved in cooperation with the engineers of the Dravo Corporation. Here two lines of the Pennsylvania Railroad cut into the steep hillside, the lower line only 6 ft above pond elevation and located on rock fill which extends into the river to a depth of 65 ft. The final solution was to move out into the river 115 ft from the shore line. Here, on the original river rock bottom, a wharf was constructed consisting of eight independent circular sheetpiling cells each 20 ft in diameter on 65-ft centers with two larger cells in the center to support the unloader. The wharf is designed to resist an ice push of 5,000 lb per lin ft applied at water level, with a factor of safety of 4 against overturning.

The silt is unloaded from the barges by a clamshell bucket into a bunker whence it is flushed to centrifugal pumps and pumped through a 12-in. pipeline 1,600 ft long to the coal washing plant on the hill approximately 275 ft above the river (Fig. 1).

Another perplexing problem was how to install this 12-in. raw-silt pipeline. The lower line of the Pennsylvania Railroad was too close to the water both in plan and in elevation for the use of a tunnel underpass. The problem was solved by crossing under this line with a number of 16-in.-diameter sleeves and electric conduits located in a reinforced concrete slab immediately below the track ballast. The sleeves and the slab were laid without interrupting rail service.

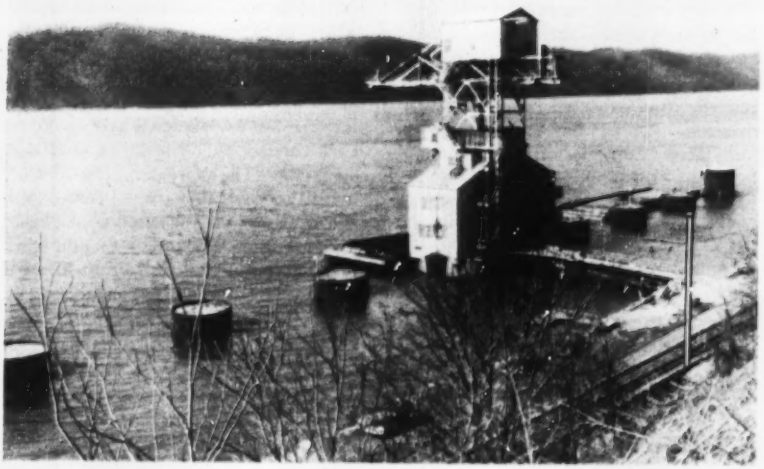
Beginning at the point where the sleeves emerge from under the lower track, a tunnel 5 ft wide, 6 ft 6 in. high, and 185 ft long was built to carry the pipes under the upper track. This tunnel terminates in a shaft 62 ft high which rises to the surface at the bench of the upper railroad. Thence a bench was cut out of the hillside to carry the pipes to the top.

At the washing plant, the raw silt is passed through a 65-ft-diameter hydraulic classifier where the minus 200-mesh fraction is removed. The deslimed silt is then separated into coarse and fine fractions by high-speed vibrating screens the cut being made at about 35 mesh. The coarse fraction is cleaned on reciprocating coal-washing tables while the fine fraction is concentrated in froth flotation cells using pine oil and fuel oil as reagents. The reciprocating tables or shaker tables, are common in the coal recovery industry and are widely used also for the recovery of other minerals. The reciprocation of the table deck and the flow of water across it separates the coal from sand, slate, and other waste of high specific gravity.

The froth flotation process is fairly new in the coal fields, but is used elsewhere to concentrate a vast variety of materials. In froth flotation, the coal is given a very low apparent specific gravity by air bubbles which adhere to the coal but not to the sand. The floating coal is removed from the tank by rotating paddles.

Mounting of the ten high-speed vibrating screens on the second floor of the main washing building presented a unique design problem. Although the screens are spring mounted, enough vibration is transmitted to the building to require unusual design of the steel and the second-floor concrete slab. Excessive amplitude of vibration was prevented by using steel considerably heavier than required to carry only live and dead load, and also by making the reinforced concrete floor slab 12 in. thick.

In the coal-recovery plant, wide use is made of centrifugal slurry pumps and



Barge wharf consists of independent circular sheetpiling cells of 20-ft diameter driven into rock. In center, two abutting cells 35 ft in diameter, joined by two sheetpiling diaphragms, form base for clamshell bucket unloader and raw-silt bunker. Unloader structure actually rests on clusters of 14-in. H-beam piles driven through sand and rock fill of cells into rock bottom of river.

pipelines to transport silt, coal, sand, and slimes. Where heavy abrasion was expected, these pumps were installed in duplicate so that one set can be removed for inspection and repair. Also, in the manufacture of the pumps, extensive use was made of abrasion-resistant alloys such as Ni-Hard. To facilitate repairs, each slurry pump installation is provided with an overhead crane or monorail hoist.

Since pipeline velocities would be a critical factor, sufficiently high line velocities were selected for the individual pipelines to prevent the settling out of solid particles. Line velocities range from 12 fps for the raw silt down to 6 fps for the centrifuge and cyclone effluent. Slurry-pump capacities were dictated primarily by the solids content desired in the pump discharge. In the plant, the peak design solids concentrations vary from about 10 percent by weight for the sand refuse pump, to 30 percent by weight for the material being pumped from the bottom of the deslimer.

The slurry pumps with the heaviest duty are the 10-in. ones which move the raw silt from the unloader to the coal-recovery plant through a 12-in. pipe. The design pumping rate is 4,200 gpm, giving a line velocity of 12 fps and a solids concentration of 17 percent by weight. The raw-silt pumps were arranged in two sets of three pumps each, connected in series and developing a total head of 150 psi. Each pump is driven by a direct-connected 250-hp induction motor. Although two pumps could have been used, it was believed that the third pump would more than pay for itself in reduced overall maintenance costs. When multi-stage pumping of solids is resorted to, individual pumps piped in series are used rather than a single multi-stage unit as in the case of water pumps. This follows from the frequent inspection and replacement of parts required, and also because it facilitates the necessary individual adjustments of stage clearances.

Standard-weight steel pipe was used generally as the piping material in the coal-recovery plant, except for the raw-silt pipe, a 12-in. pipe with a wall $\frac{1}{2}$ in. thick. At changes in direction, a number of rubber-hose bends ranging in size from 4 to 12 in. were employed. To obtain data on comparative life, in many lines both rubber-hose bends and steel-pipe bends were employed. Plug valves were used almost exclusively on solids handling lines.

Since a choke-up in the raw-silt line would stop plant operation completely, a unique dump valve was installed at the low point of the line at the river's edge. When the line velocity falls below a predetermined minimum, the entire content of the raw-silt pipe is automatically dumped at a rate which insures clean flushing of the line.

After washing at the recovery plant, the coarse and fine fractions of coal are combined and pumped almost a mile to the dewatering plant and railroad loading facilities. Here, the coal is dewatered by a combination of cyclones and solid-bowl centrifuges. The cyclone is merely a conical vessel with the apex at the bottom; the coal slurry is jetted into the top tangentially and the kinetic energy is utilized to whirl off some of the excess water. There are no moving parts. The centrifuges, which receive the thickened slurry from the cyclones, consist of horizontal conical bowls rotating at high speed, producing a centrifugal force of approximately 300 *g*. The dewatered coal is loaded into the railroad cars by belt conveyors.

The plant conforms in every respect with the provisions of the clean streams program of the Commonwealth of Pennsylvania, which calls for disposal on shore of all waste removed from the river. The large tonnage of slimes waste is first concentrated in a 150-ft-diameter clarifier and then run by gravity to a refuse disposal basin established by damming the mouth of a nearby valley. The presence of this bowl-shaped area was a major factor in selecting the exact site for the coal-washing operations. The sand waste also is pumped to the refuse disposal area and used to build up the height of the dam. In approximately 40 years, these waste sands will build the dike up to a height of about 275 ft, providing a disposal area with a capacity of over 21 million cu yd. The final run-off to a nearby creek has a solids content within the limits established by Pennsylvania state authorities.

Dewatering cleaned coal

The last step in the recovery program, dewatering of the cleaned coal, takes place in the centrifuge building about 4,000 ft from the washing plant proper. The plant arrangement required that the centrifuge building be constructed on an alluvial deposit composing the bank of an adjacent creek. Because of the vibration expected from the heavy rotating mass of the centrifuges, the foundations, not only of the centrifuges but also of the building column footings, were carried down to rock, 14 to 15 ft below the surface. Prepakt piles were used as being the most economical. With an air-driven auger, a hole 12 in. in diameter was first drilled down to rock. If the material tended to collapse, a casing of 12-in. pipe was forced down behind the auger. After the auger was withdrawn, a cage of reinforcing rods was lowered and the hole was packed with aggregate. The casing, if used, was withdrawn and grout was pumped into the hole starting at the bottom, using a $\frac{3}{4}$-in. pipe which had been placed in the hole before it was filled with aggregate. A total of 62 such piles were placed for the centrifuge building. Their design capacity was 30 tons each.

Pipeline bridge to centrifuge

The 8-in. pipeline carrying the clean coal to the centrifuge building and the 10-in. line carrying the centrifuge and cyclone effluent to the waste disposal area had to be carried across a creek, about 150 ft wide, which lies between the main washing plant and the centrifuge building. To carry these pipelines, a two-span truss bridge 200 ft long was erected.

The center pier of this bridge was to be located in the creek bed, which consisted of a 4- to 12-ft-thick layer of sand, gravel, and large stones over a solid rock bottom. The bed material was first consolidated by pumping grout into it, and the consolidated mass was doweled into the rock bottom. The pier foundation was then formed and carried above the water level by the Prepakt method. The pier itself was poured with conventional concrete. This construction procedure eliminated the expense of unwatering the site of the center pier and excavating down to solid rock.

The superstructure of this pipe bridge, like that of the barge unloader on the Susquehanna River, was of all-welded construction. Other structural steel on the project was assembled by means of Dardelet bolts. No field riveting was used.

Ground clearing for the coal-recovery plant was begun in April 1952 and the plant was placed in experimental service in October 1953. Operation started smoothly and with few difficulties, and for these few, solutions were in sight by the time the plant shut down for the winter. The initial operating period extended until the middle of December, when operations were suspended until the spring of 1954.

The Western-Knapp Engineering Co. of New York, as engineers and agents for the Pennsylvania Water & Power Co., carried out the design and construction of the shore plant from the unloader to the rail yard. Pennsylvania Water & Power Co. acted as engineers and as prime contractor for the river fleet and clean-coal yard and as coordinator of design, construction, and inspection on all phases of the project.

(This article has been prepared from the paper by Messrs. Levin and Smith presented at ASCE's Atlantic City Convention, before the Power Division session presided over by Byron O. McCoy, chairman of the Division's Executive Committee.)

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FIG. 1. Greenwich-Killingly Expressway will replace old Boston Post Road (Route U.S. 1) for 129 miles along Connecticut shore between New York and Rhode Island.

Expressway crosses New Haven harbor front on hydraulic fill

The Boston Post Road, Route U.S. 1, which follows the shore line between New York and Providence, R.I., has long been a major artery in the development of our country and of the State of Connecticut. This route formerly passed through the heart of New Haven, Conn., where substantial growth of traffic had resulted in the usual congestion and accidents. This was in spite of the fact that much had been accomplished at the local level to improve traffic flow by signal control, one-way streets, parking regulation, and other methods.

New Haven is located at the head of a broad, deep bay. Its site is a level, sandy plain, behind which rises a line of hills. The early importance of the city as a port caused an intense development from the harbor front inland and, as the city grew, the areas between the harbor front and East Rock and West Rock became closely built up. The early development of the city, as is the case with many New England cities, did not include provision of a street system adaptable to the traffic needs of today. The street pattern is radial, the area from the harbor front to the original 9 squares serving as the hub of the wheel.

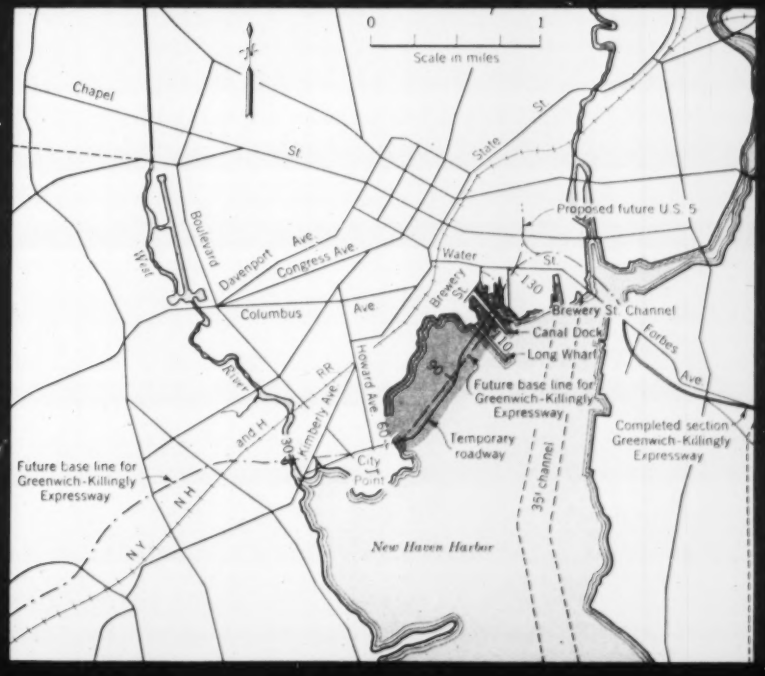
Figure 1 shows the approved Interstate Highway System in Connecticut. This system, established as a result of the 1944 Federal Highway Act, connects virtually all cities of 100,000 or more population. New Haven is located at the junction of U.S. 1 and U.S. 5. Route 1, connecting the New York metropolitan area with Boston, is to be known as the Greenwich-Killingly Expressway. Route 5 connects New Haven and Hartford with Springfield, Mass., and northern New England.

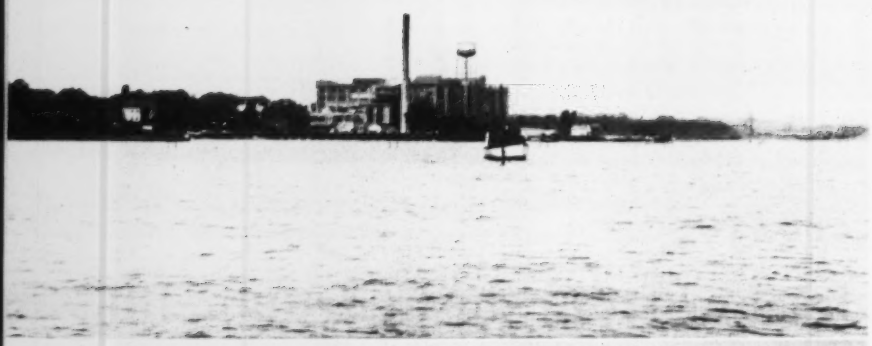
Traffic study made

If any proposed expressway is to be located and designed to provide the maximum service commensurate with the cost, it is necessary to obtain and analyze comprehensive traffic data, such as for origin and destination, volume, composition, and expected growth. An origin and destination survey centered about the city of New Haven was initiated in the fall of 1945. It shows that 153,400 vehicles passed into and out of the city on an average day in October 1945. Altogether 21,900 interviews were obtained, representing 14 percent of the total traffic.

The survey indicated the major traffic importance of the adjacent town of West Haven to the west of New Haven. The importance of central New Haven, as the prime traffic generator, was clearly shown. Of greatest significance, however, is the fact that only 1,800 daily

FIG. 2. Expressway bypasses city of New Haven, Conn., by relocation on dredged and stabilized fill for two miles across New Haven harbor front. Temporary route was opened for traffic in January 1954, and final construction will be completed in 1956.





Harbor front of New Haven, Conn., as it appeared before placing of hydraulic fill is seen at left, looking north. Same view after fill has been placed is shown below. Location on this fill makes it possible for expressway to bypass congested New Haven area.

vehicles, 11 percent of the total traffic through the westerly station and 13 percent of the traffic through the easterly station, passed through both stations. If there is one conclusion to be drawn from this traffic survey, it is that through traffic on U.S. Route 1 in New Haven is of minor traffic importance, and that the major traffic flows are from the adjacent towns on the west to the center. Not until such traffic data were available was it possible to proceed with sound location studies for the urban expressway system.

New Haven harbor dredged

We now turn to the physical aspects of the project. The River and Harbor Act of the Federal Government, approved July 24, 1946, provided for the improvement of New Haven harbor by deepening the main channel and turning basin from El. −25 to −35 (mean low-water datum) and for the widening of both. A condition of the Act was that local interests should furnish, free of cost to the United States, suitable bulkhead spoil disposal areas.

The U.S. Corps of Engineers indicated that the northwest part of the harbor, between Long Wharf and City Point (Fig. 2), would provide a most desirable disposal area because of its close proximity to the upper harbor dredging and its relatively large size. The Corps offered to deposit about 5,000,000 cu yd of spoil in this area to provide fill for future highway development. Immediately the relocation of Route 1 in the New Haven area became the top priority project in the State Highway Department.

With the 1945 traffic survey data at hand, the department was in a position to complete the alternate location studies in the New Haven area. The final choice of location was between (1) the harbor-front location, and (2) a route generally paralleling the main line of the New York, New Haven and Hartford Railroad. While the location along the railroad would admittedly provide greater traffic service than the harbor-front location, construction costs for the former would be considerably greater. The estimated right-of-way costs were many times greater for the railroad line, because of the intensely developed area through which that line would pass.

On the basis of the three main location factors—traffic service, total cost, and impact on the community—the department selected the harbor-front route. It should be emphasized that the impact on the city of New Haven, which would have resulted in removal from the tax rolls of an estimated $7,000,000 of property values along the railroad line, as compared to the reclamation of new land on the harbor front over and above that required for highway purposes, was a most significant factor in the department's decision to adopt the harbor-front location.[1]

The first channel improvement contract of the U.S. Corps of Engineers was awarded to the Arundel Corporation of Baltimore, Md., in 1947 for the dredging of 3,200,000 cu yd in the upper harbor. Dredging started on March 4, 1948, and was completed in August. All the material in this contract was placed in the Long Wharf–City Point disposal area.

The second channel improvement contract of the Corps of Engineers provided for the dredging of some 6,000,000 cu yd from the remaining 5 miles of channel to complete the Corps' channel improvement project. Of this, about 1,000,000 cu yd was placed in the Long Wharf–City Point area in 1949, by the American Dredging Co. of Philadelphia. A further channel widening project provided an additional 300,000 cu yd of spoil, which was placed in 1949 in the lower part of the same area by the American Dredging Co.

Foundation problems

While the complexity of the problems presented by the construction of a six-lane expressway along the harbor front was largely a matter of drainage and the integration of many varied operations,

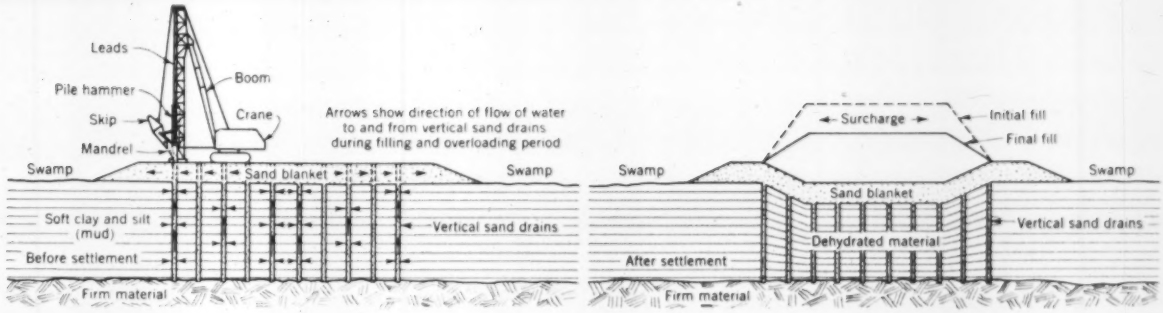


FIG. 3. Water in surcharged hydraulic fill has been slowly squeezed out through vertical and horizontal sand drains to stabilize foundation. Settlement over three years has been 7 to 9 ft. Removal of overload fill will insure against future settlement.

the difficulty of the location was mainly due to the poor foundation conditions. The foundation problems can be readily measured in terms of the length, width, and depth of the mud. The extent of the area in terms of length and width can be seen from Fig. 2.

Many areas along the shore line have been reclaimed in the 107-year period from 1840 to 1947. The length of shore line involved in the present project, measured along the center line of the expressway from a point in West Haven near the present railroad crossing to the upland near Water Street in New Haven, is two miles. The width of reclaimed area midway between City Point and Long Wharf is about 1,700 ft. About half the area of 210 acres between Long Wharf and City Point, shown darkly shaded in Fig. 2, will be filled to high water or above.

The nature of the material underlying the harbor was examined by borings. Soft grey organic clayey silt was found for a distance of 30 ft from the harbor bottom from El. −5 to El. −35. This material has a natural water content of about 100 percent, a liquid limit of 82 and a plasticity index of 44. Its natural shearing strength varies from about 100 psf at the top to 250 psf at the bottom. Beneath this mud, there is a stratum of medium brown sand and silt about 10 ft in thickness. Below this there is brown silt with some fine sand to El. −105. One boring, adjacent to West River, was carried down to El. −200 through the same material.

Some years ago it was the practice of our Highway Department, when building across swamps and other soft areas, to remove soft material lying above firm foundation and then backfill with selected material. Along the harbor front, however, it would have been wholly impractical to take out the muck. More recently, as the result of increased knowledge and experience in the field of soil mechanics, it has been found that under certain conditions a considerable saving in time and cost can be effected by consolidating unstable soil by installing vertical sand drains. The operation of sand drains, or sand drainage wells, is shown graphically in Fig. 3.

Ordinarily the first step in the installation of sand drains is to place a sand blanket 3 to 6 ft in thickness over the surface of the soft area. This blanket serves three purposes: (1) it supports the crane and other construction equipment; (2) it adds weight to the surface and compresses the mud; and (3) it drains away, in a horizontal direction, the water which rises in the vertical sand drains under hydrostatic pressure. The mandrel, made of pipe 12 to 24 in. in diameter, is driven through the sand blanket and mud to the desired depth, which may vary from 10 to 100 ft. The mandrel is filled with coarse sand and then gradually withdrawn, leaving a vertical column of the free-draining sand. Sand drains are placed on 6- to 20-ft centers, depending on the character of the soil and the time available for construction and stabilization.

Additional fill is added as the soft ground dehydrates and settles. The amount or weight of fill added governs the rate and amount of consolidation. Conditions on this project were well suited to the sand-drainage-well method of consolidation.

Constructing the fill

The two previously mentioned dredging contracts let by the Corps of Engineers resulted in the placing, in 1948 and 1949, of about 16 ft of sand fill over the length and width of the expressway and frontage roads, and lesser amounts on each side. By 1951 this fill had settled about 3 ft.

Next, in 1951 the state contracted with the Arundel Corporation for more hydraulic fill—about 3,000,000 cu yd. To insure a free-draining sand blanket, a 4-ft layer of clean, medium-to-coarse sand, from a nearby sand bar known as Shag Bank, was first pumped onto the expressway area to be stabilized through the use of sand drains. This sand layer brought the expressway area up to about El. +12.

Contracts for sand drainage wells were let as two separate types of projects. The first was in connection with bridges, where wells of 12-in. diameter were called for. These were installed by jetting down a closed-end 12-in. pipe through the sand and mud to the bottom of the mud. It was later decided to provide sand drainage wells under the expressway; these were of 20-in. diameter, and were installed by driving, rather than jetting, a 20-in. closed-end pipe. Additional 20-in. wells were installed at bridges where 12-in. wells were already in place. Spacing of wells was 10 to 12 ft on centers.

Immediately after installation of the sand wells in an area, horizontal drains were installed in the sand blanket. In most areas these drains were of $^1/_2$ or $^3/_8$-in. stone, 2 ft, high, 2 ft wide at the bottom, and 3 ft wide at the top. These were to aid in draining away the large amounts of water which entered the blanket from the wells and from the hydraulic fill to be placed later. These horizontal drains were placed transverse to the center line of the expressway and spaced about 100 ft on centers. Two longitudinal drains, one 50 ft to the left and one 50 ft to the right of the center line, were also installed.

In one large area, 6-in. perforated asphalt-coated corrugated metal pipe was used instead of the stone for draining the blanket. Because settlements are large and greater at the center line than under the side slopes, the transverse drains become curved and tend to stretch. Such stretching might rupture the pipe at the joints and result in large amounts of sand being carried into the pipe, particularly since the embankment above was to be placed by the hydraulic method. To permit the pipe to stretch safely, the conventional bolted bands at each joint were omitted and an 8-in. asphalt-coated corrugated metal pipe, 3 ft long, was substituted as a sleeve.

Additional hydraulic fill followed the

Effluent builds up fill along New Haven harbor front during hydraulic pumping operations of Corps of Engineers in connection with harbor dredging project.

Temporary roadway for relocated U.S. Route 1 is seen looking east from City Point, toward New Haven business district in distance. Fill for final expressway location is at left. Temporary route utilizes frontage roadway on one side of main alignment, then crosses over to follow frontage road on other side, as shown in Fig. 2.

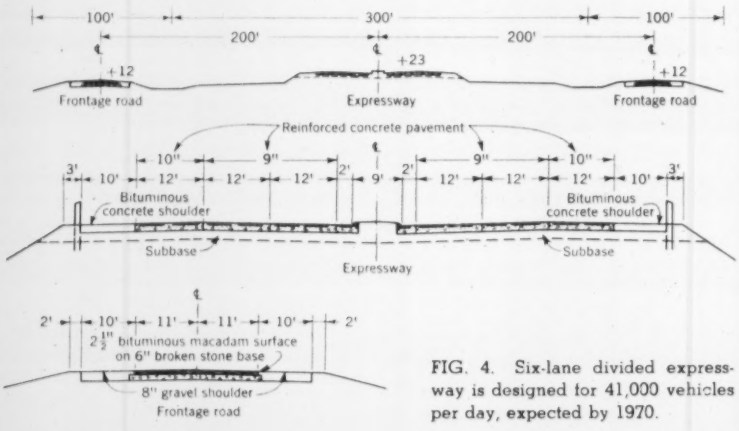


FIG. 4. Six-lane divided expressway is designed for 41,000 vehicles per day, expected by 1970.

installation of the horizontal drains. To avoid overstressing the consolidating mud foundation, this additional fill was placed slowly, at rates of 1 or 2 ft of height per week, until the expressway fill and the frontage-road fills were up to about Els. +23 and +12, respectively. Also, as a part of this 3,000,000-cu yd contract, hydraulic fill was placed to similar heights between Long Wharf and the mainland at the north end of the project, and between the boulevard and the railroad at the opposite end of the project. At these locations, the same sand-drain treatment was used.

The latest contract on this project was to grade and pave the two-lane temporary roadway which runs from Kimberly Avenue to Brewery Street, as shown in Fig. 2, and to add fill for the expressway embankment. The roadway follows the line of a future approach ramp at Kimberly Avenue then follows the eastbound expressway lanes to City Point, and then the outer frontage road to Sta. 90. At that point, it crosses the expressway alignment and follows the inner frontage road to the end at Brewery Street. Fill for the expressway, also part of this contract, raised the embankment to final grade plus a 6-ft overload. At future bridge sites, the overload was increased to 10 ft.

One of the important consequences of using the 30-ft silt-clay foundation stratum has been large settlements. For example, a 25-ft fill will result in an ultimate settlement of 7½ ft, and a 35-ft fill will cause a 9-ft settlement. These settlements are slow; 50 percent 20 months after the fill is placed, and 75 percent 30 months later. The remaining settlement is at an even slower rate.

These slow settlements would be harmful to drainage installations and to pavement, particularly at bridge ap-

TABLE I. New Haven harbor-front projects for relocation of Route U.S. 1, 1947–1954

Description	Contractor	Cost
Twin 6 × 4 ft box culvert, outfall sewer	C. W. Blakeslee	$ 153,575.40
Brewery Street culvert	C. & T. Const. Co.	29,937.05
Cross culvert at Sta. 24 + 0	C. W. Blakeslee	68,113.00
Twin 6 × 6-ft box culvert and reinforced concrete pipe installations	C. W. Blakeslee	504,265.75
Steel sheet retaining bulkhead at Brewery St. Channel	C. W. Blakeslee	79,024.00
Bypass sanitary sewer on Chestnut St., and railroad yard drainage	Jos. F. Kelley Co.	21,023.00
Protection for Meadow St. interceptor sewer	C. W. Blakeslee	196,409.30
Howard Ave. grade separation and approaches	D. V. Frione & Co.	158,233.35
Dredging in Canal Dock area (Alternate B)	New England Dredge & Dock Co.	8,750.00
36-in. storm-water cross culvert at Sta. 90 + 0	N. Benvenuti & Son	79,745.45
Overpass at Sta. 72 + 80—grading, drainage, overpass	C. W. Blakeslee	269,885.31
Sand drainage wells, 12-in.	C. W. Blakeslee	68,686.12
Hydraulic fill (3,000,000 cu yd)	Arundel Corp.	2,390,847.31
Extra by construction order	Arundel Corp.	284,808.11
Sand drainage wells, 20-in.	Savin Const. Corp.	193,592.40
Extra by construction order	Savin Const. Corp.	89,212.99
Relocation of Meadow St. interceptor	Mariani Const. Co.	59,086.00
Temporary roadway	Elm City Const. Co.	394,338.20
	Total	$5,349,532.74

proaches; also they result in a very slow increase in the shearing strength of the mud, which means that the fills must be placed slowly to conservative heights and with very flat side slopes. For this reason the sand drainage wells were installed for the entire length of the project for the full width of the expressway location, and also at the sides of most structures. This permitted using 2:1 slopes at the sides of the expressway. Also, the placing of an overload, and its removal before the pavement is placed, will eliminate nearly all long-time settlement. The beneficial effect of the sand wells was as expected; settlements in areas treated with wells were about seven times as rapid as in similar untreated areas.

Other structures built

During the progress of the work described, many structures were built because of, and as a part of, this harbor-front project. Most of them involved difficult problems. They are listed in chronological order.

1. A twin box sewer, 6 × 4 ft, 1,200 ft long, from the sewer diversion chamber northeastward to near Canal Dock.
2. A cross culvert of 36-in. cast-iron pipe, 500 ft long, at Sta. 105 + 90.
3. A cross culvert like the above (No. 2) at Sta. 90 + 0.
4. A grade-separation bridge at Howard Avenue (the only structure without piles).
5. A reinforced concrete protection slab, 36 in. thick, 15 ft wide and 800 ft long, over the Meadow Street interceptor sewer of 36-in. cast-iron pipe, where the highway crosses it at Sta. 66.
6. Three 6-in. oil lines, each about 1,700 ft long, leading to a temporary dock at Canal Dock.
7. A steel sheet bulkhead across the Brewery Street channel, 600 ft long, on the east side of the expressway.
8. Extension of No. 1 above, in the form of a 6 × 6-ft box culvert for 1,300 ft along the Canal Dock to the bulkhead (No. 7 above).
9. Extension of a storm sewer of 42-in. cast-iron pipe parallel with No. 8 above.

In addition to these nine structures, there will be three highway grade-separation bridges, a long viaduct over the West River and Kimberly Avenue, and a very high grade-separation over the main line of the New York, New Haven & Hartford Railroad.

The nine structures now in place rest on a total of 4,070 timber piles, nearly all 60 to 80 ft long. They were imported from Maryland and the Carolinas, as local piles more than 40 ft long are scarce. The average contract price for furnishing them was 75 cents a foot, and for driving them, 40 cents a foot.

In addition to the load of the structure and fill above, these piles obviously receive an additional load due to the drag by the adjacent fill and mud beneath on the structure and on the piles while the fill and mud settle. To allow for this drag in the design of the piles, it was assumed that the drag occurred as a shear along a vertical plane passing through the edges of the structure. In sand the lateral pressure normal to this plane was assumed as active pressure. When this drag, amounting to about 15 tons per pile, was added to the customary load calculated for the piles, it increased their unit load to 35 or 45 tons. The validity of the pile design is borne out by the fact that settlements of these structures has been only $\frac{1}{2}$ to 2 in., whereas adjacent fills have settled many feet.

The relation of the 6-lane expressway to the frontage roads which will parallel it on each side through the harbor-front area is shown in Fig. 4. It will be noted that reinforced concrete pavement is specified for the expressway. It is probable, however, that a flexible pavement will be used for the initial riding surface. This decision will be made when the Greenwich-Killingly Expressway is ready for paving.

The Connecticut State Highway Department engaged the services of Porter-Urquhart Associated to supervise its hydraulic-fill work and most of the sand-well drainage work. Prof. Arthur Casagrande, M.ASCE, of Harvard, was engaged to advise on certain phases of the steel bulkhead placed across the Brewery Street Channel, when difficulty was encountered. The services of these consultants proved of great value.

Contracts are listed in Table I.

When the remaining structures are built and the expressway is paved, this harbor-front section will be an important part of the 129-mile Greenwich-Killingly Expressway, which will traverse the state from New York to Rhode Island. Construction of the sections beyond the ends of the New Haven harbor-front project will be started fairly soon, and the harbor-front portion will probably be completed in 1956. The temporary roadway was opened to traffic in January 1954.

For the State Highway Department, M. A. Kaehrle, A.M. ASCE, was former Assistant Director, Bureau of Traffic-Planning-Design. Philip Keene, A.M. ASCE, is Engineer of Foundations, and D. S. Johnson is Engineer of Planning.

(This article has been prepared from the paper which Mr. Perkins presented at the ASCE Atlantic City Convention, before the Highway Division Session presided over by Roy E. Jorgensen, M. ASCE.)

Contributions of EJC on a profession-wide basis

THOMAS A. MARSHALL, JR., Secretary, Engineers Joint Council, New York, N.Y.

Now let me tell you a little about the history of EJC, why and how it came into being. It was formally organized in 1941 as the Engineers Joint Conference. The Conference grew out of a liaison relationship that had existed between the secretaries of the four Founder Societies (ASCE, AIME, ASME, AIEE) for many years.

Early in the mobilization immediately preceding our entrance into World War II, the Founder Societies received a number of requests from various governmental activities for information and aid in areas of interest to the profession. It was decided that a more formal organization was needed, and the Engineers Joint Conference was established in 1941. At that time it was composed of the presidents and secretaries of the participating societies. The American Institute of Chemical Engineers become the fifth participating member in 1942.

As the scope of its activities expanded, the functions of the organization became of greater significance than that implied by the word "Conference." The name was changed to Engineers Joint Council in September 1945. Representation of the constituent societies was increased and a formal constitution adopted.

In 1949, Engineers Joint Council, through its Committee on Increased Unity, sponsored a meeting to discuss the development of increased unity within the engineering profession. Out of this meeting an Exploratory Group containing representation from 10 other national societies, in addition to the five EJC societies, was formed. During more than two years of study, the Exploratory Group developed a plan, acceptable to most of its members, submitted to EJC in January 1952.

In accordance with this plan, the constitution of EJC was modified to permit invitations to be extended to additional societies to join EJC, and at the same time to provide proportional representation of its members. On December 31, 1952, invitations were extended to 8 additional societies to join EJC. Acceptances were received from three: American Water Works Association, The Society of Naval Architects and Marine Engineers, and American Society for Engineering Education. This brought the membership of EJC to 8 constituent national societies having a total membership in excess of 170,000, not counting students.

Three of the 8 societies invited to join—the American Association of Engineers, American Society of Heating and Ventilating Engineers, and the Institute of Aeronautical Sciences—took no action on the invitations, which expired on December 31, 1953.

Two of the eight rejected the invitation. One of these, the Institute of Radio Engineers, requested continued cooperative activity with EJC on specific problems of mutual interest. Its rejection was dictated by two basic policies of long standing—that it cannot engage in legislative activity and that it cannot, as a society, represent its members as individual members of the engineering profession, or, as a body, on social or general professional matters.

The other society that rejected the invitation was the National Society of Professional Engineers (NSPE), which declined after considerable study, and after meetings between a special joint committee, consisting of three members of EJC and three representatives of NSPE. While NSPE did not accept at this time, the study resulting from the joint committee did much to further a mutual understanding between the two organizations. In addition, it has provided a very valuable document for the guidance of EJC. The Joint Committee is being continued to further explore areas of mutual cooperation between the two societies.

Organization and objects of EJC

The present Engineers Joint Council is composed of 19 representatives of the 8 constituent societies in proportion to their membership. Representatives and alternates on the Council must be members of the governing boards of the societies they represent. The presidents of the constituent societies are ex-officio members of the Council. The president and vice president of EJC and the members of the Executive Committee are elected from among the representatives at the Annual Organizational Meeting to serve for one year. The EJC Constitution provides that the president, the vice-president, and the other members of the Executive Committee must each be from a different society.

There is ample recognition in the objectives of EJC, as expressed in its constitution, of the necessity to provide a balanced program. EJC carries on activities both in the national welfare or public service area and in the professional area.

Public service activities

In the first category is its Committee on Engineering Sciences which cooperates with the National Science Foundation in initiating and developing basic research. That committee also assists members representing engineering on the National Science Foundation Board. It has a task committee working actively with the National Science Foundation on the development of the engineering section of the National Scientific Register.

The EJC Committee on International Relations acts as a coordinating agency between the profession in the United States and abroad. The committee has been working actively with the Pan American Federation of Engineering Societies (more familiarly known as UPADI). (EJC is the United States member of UPADI.) The committee was instrumental in helping to rebuild the engineering libraries of war-torn countries by acting as a clearing house for contributions of books that were delivered through the United States Book Exchange.

I have already commented on some of the work of the EJC National

In this second of two articles on the subject of unity of the profession, Mr. Marshall gives a brief history of Engineers Joint Council and its activities of interest to the individual engineer as well as to the profession as a whole. Since April 1954, Mr. Marshall has been Director of Publicity for ASME.

Engineers Committee, the EJC National Water Policy Panel, and the EJC Atomic Energy Panel. EJC also has an Advisory Committee to the Lewis Historical Publications, the official publishers of *Who's Who in Engineering*.

EJC activities in the professional area

In the area of professional development, EJC is continuing, through its Special Surveys Committee, its surveys of supply, demand, and professional income. A study of Professional Income of Engineers in 1953, covering the incomes of nearly 70,000 engineers employed in industry, education, and government has just been released.

The Engineering Manpower Commission of EJC has been working actively for the past three years to secure the most effective use of engineers in the national health, safety, and interest. It has done much to stimulate the interest of qualified high school graduates in careers in engineering. It has also done much to promote more effective utilization of engineers, not only by the government, but also by industry. The activities of the Commission actually lie in both areas—professional and national welfare.

Of major significance in the professional area, however, is the work of two committees. First, the Committee on Employment Conditions through the constituent societies is making a study of employment conditions for engineers. It is hard at work studying the interest of engineers in collective bargaining, in professionalism, and in other activities that affect their employment conditions.

Second is the Committee on Recognition of Specialties in Engineering, organized as a result of a suggestion from the Joint Committee on the Advancement of Sanitary Engineering. The need for the recognition of specialties was emphasized by the difficulties encountered by sanitary engineers in being recognized as competent within their specialty, especially by those outside the engineering profession, since sanitary engineers work closely with the Public Health Service and with the medical profession. Current thinking is along the lines of specialty boards to examine candidates in a manner somewhat similar to that employed in the medical profession. When the plans have been worked out in detail they will unquestionably be extended to other fields such as hydraulics and nuclear engineering.

Other EJC activities

EJC is changing. It is entirely different now from what it was two years ago. As its activities progress, and as the Council studies and implements the recommendations of the Exploratory Group, it will continue to change. It may well become the unity or solidarity organization for our profession.

In this connection, there are two most important activities to which I would like to invite attention. One of the recommendations of the Exploratory Group had to do with the affiliation of state, regional, and local societies with EJC. A special committee is now actively working on that problem. I expect an announcement to be made in that area shortly. That same committee is also studying the affiliation of national societies that meet all the requirements for EJC membership except that of size.

The second activity of interest is the matter of individual participation in EJC. This is deemed to be of such importance that the Executive Committee is devoting additional time to the problem. Those of us who are close to EJC believe that real progress will also be made here.

To develop a channel of communications between individual engineers and EJC, we are planning a bimonthly bulletin. This bulletin will be distributed to local, regional, and state engineering societies and councils. It will be published in the journals of our national societies. Through this medium, we hope to be able to tell the individual members of the profession what EJC is doing and how it is developing. We hope the individual members will follow this news and let us have their suggestions for improvements, especially improvements that will help build EJC into the organization we, as engineers, want and need.

Conclusions

If, in its activities, Engineers Joint Council gains the support of the individual members of the engineering profession, it can become the unity organization we have all been looking for. To be successful, however, it must have the interest and support of the individual engineer.

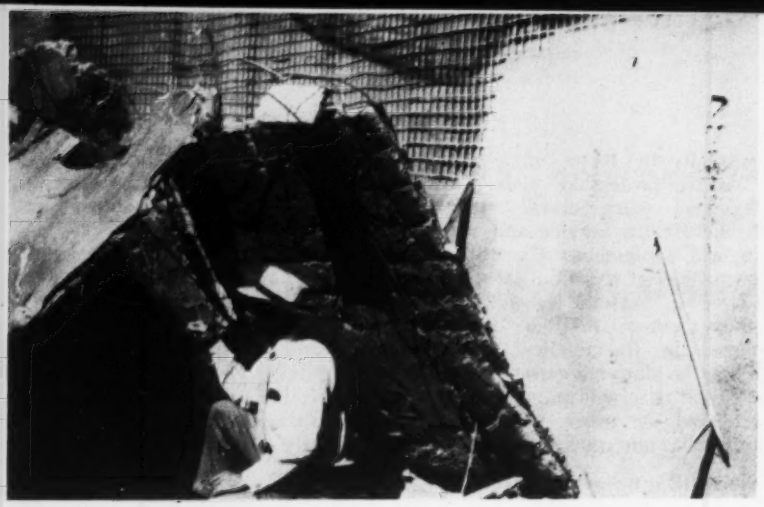
Let me caution you that if you desire a collective bargaining agency as a unity organization, then you will have to look elsewhere. EJC cannot and will not become a collective bargaining agency, nor will the existing technological societies.

To those who point to the strength of unity organizations in the medical and legal professions, let me point out that both of those professions are predominantly self employed. There is no collective bargaining problem there. I am firmly convinced in my own mind, that to attain recognition and true professional status especially in the eyes of the public, we need to encourage *initiative*, *resourcefulness*, *creativity*, and *individual incentive* among the members of our profession. These will be the tools through which we can develop engineers professionally, improve the practice of engineering, and provide effective services by our profession to the national welfare, or in the public interest. These factors are the direct opposite of collective bargaining.

We, as professional people, have an obligation to devote a share of our time, efforts, and funds as a service to the nation in matters affecting the national welfare or in the public interest. If we do not carry on such activities, we will not maintain a professional status.

Activities of the type carried on by EJC are mandatory. It is of tremendous significance that only a year after AEC ceased its operations, we were forced to form another organization—EJC—to fill this need or concede that the engineering profession as a whole was voiceless in matters of national concern. Since 1917, we have had, except for one year, an organization actively engaged in such operations.

I believe a successful and continuing unity or solidarity organization to serve the engineering profession can be built upon the framework already established in EJC and the developments it is undergoing, if we will lend it our *constructive* support. Unless we build EJC into the spokesman for our profession in these areas of activity, we will find ourselves represented by other, less qualified, organizations hardly distinguishable from labor unions. What we as individuals get from EJC—or from any other organization for that matter—will be in direct proportion to what we as individuals put into it.



← Roof of original structure collapsed as immediate result of premature removal of centering. Probably this was fortunate as it led to investigation which revealed basic weaknesses. Tank would have failed in any event when filled with water.

→ Completed tank is monument to engineers' ingenuity in carefully redesigning and reconstructing original structure, built without benefit of engineering.

Prestressing rehabilitates concrete water tank

ALFRED J. RYAN, M. ASCE

Consulting Engineer, Denver, Colo.

Failure of the dome roof of a 1,500,000-gal water storage tank in Aurora, Colo., during construction was the subject of a great deal of newspaper publicity. The miracle that none of the workmen was seriously injured was also highly publicized. Included in all this publicity was a small item to the effect that the cause of the failure was being investigated by engineers for the purpose of determining responsibility. The results of that investigation and the subsequent activities necessary to provide a usable water tank have purposely been given no publicity. However, they should be of considerable interest to engineers.

Several months before the accident, the officials of the city were in a serious predicament. The city had expanded rapidly and was no longer able to provide an adequate supply of water to some of its citizens. Real effort had been required to convince the citizens that the expenditure of funds for a large storage tank was essential to alleviate this condition. By the time these efforts had succeeded and the money was made available, erection of the tank at the earliest possible date was a prime necessity.

The officials had been told that the manufacturers of large tanks could bid competently on the furnishing and erection of such tanks without the plans and specifications normally prepared by an engineer. Such a procedure would eliminate both the loss of time required for the preparation of specifications and the resulting engineer's fee.

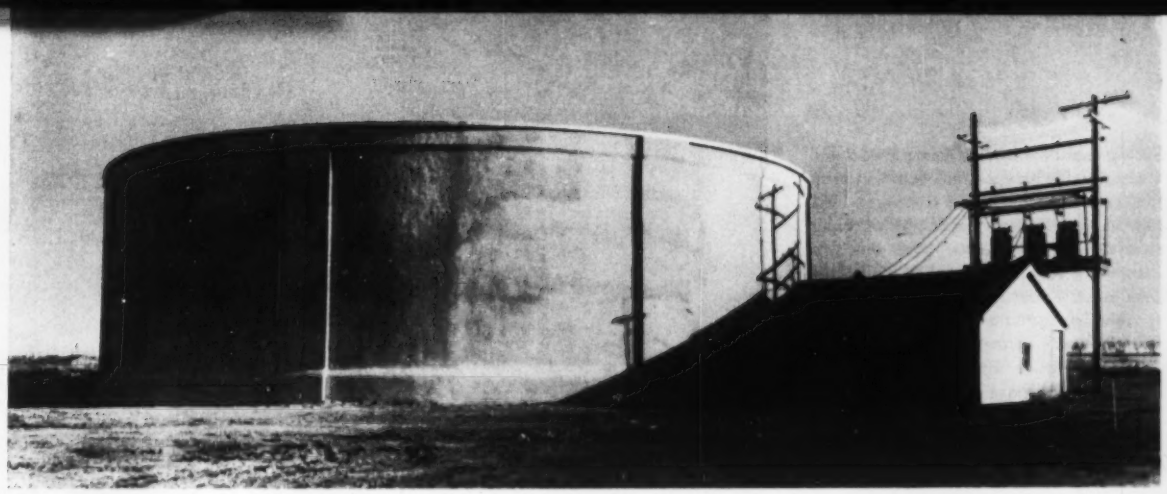
The City Council accepted these statements at face value and issued a request for bids. Several were received, the lowest from a gunite contractor who proposed a structure consisting of gunite walls reinforced in accordance with conventional design requirements, and a dome roof of reinforced gunite. In a misguided attempt at conservatism, interior columns were added to help support a roof which was supposedly designed as an unsupported dome. The contractor's proposal was accepted and his plan approved. Unfortunately, the approval was based only on general dimensions and the proposed construction methods, rather than on an engineering analysis.

Accident leads to investigation

At the time of the accident, the wall cylinder and floor had been completed and the dome was substantially complete. The failure occurred when a premature dismantling of the forms beneath the dome allowed it to collapse into the tank.

The engineering investigation revealed that both the design and the method of construction of the dome were in error, and that failure was inevitable. Of more importance, it showed that the reinforcing steel in the wall cylinder was entirely inadequate to resist the pressures to which the tank would be exposed when full of water. With the cause of failure determined, the immediate problem was how to provide a satisfactory tank—whether by building a completely new tank or by rehabilitating what was left of the original construction. Cost, time of construction, and public reaction were the basic elements to be considered.

Investigation revealed that a new tank would cost about $73,000. Moreover, this procedure would permit no appreciable saving in time and would stir up a definitely adverse public reaction. The next step was to determine a means by which the existing walls could be integrated into a safe and satisfactory tank. The methods considered included the addition of an outer cylinder of concrete, reinforced in the conventional manner, or the use of the existing cylinder as a core for a prestressed concrete type of construction with a protective gunite surface. The first method was discarded because it



involved too many indeterminate aspects, the most important of which was the problem of continuity between the old and the new concrete.

Two methods of applying prestressed steel to the outside of the existing tank were next considered. One of these was the continuous-wrap method. The other was the method of stressing steel units between pilasters built at intervals on the outer surface of the tank. After consultation with engineering representatives of the companies controlling the patents on each of these methods, the second was chosen. The company controlling the wrap method stated that they did not believe their method would provide a satisfactory tank under these particular circumstances.

In spite of some apprehension, in recognition of the risk involved, the city authorized the following rehabilitation program (see Fig. 1):

1. External application of 136 prestressed steel units to be stressed between eight pilasters located along the outside of the existing tank wall.
2. A protective coating for the prestressed steel units consisting of $^{7}/_{8}$ in. of gunite, $^{1}/_{4}$ in. of which was to be a flash coat made with white cement.
3. An interior lining of Gilsonite mastic to act as a membrane to minimize leakage.
4. A steel roof, which was preferred to a concrete roof primarily because of the saving in time of completion.

When the authorized construction was complete, except for the final exterior flash coat, the first test was made. Minor leakage at several points was evidenced by damp spots on the concrete. The location of all apparent points of leakage was noted before the tank was drained, and the causes of most of the leakage through the interior lining were determined during the subsequent inspection. After correction of these conditions the tank was again tested. This time the evidence of leakage was so minor as to be considered negligible. After application of the final flash coat, the tank was accepted by the city. Several months of use warrants the conclusion that this method of reconstruction was satisfactory.

In spite of the facts that this was an intriguing problem with a real challenge and that satisfactory results were obtained, it is hoped that no other engineers will be faced with such a situation. The really significant thing is the result of eliminating engineering services when awarding the initial contract. This ill-advised action made the tank cost almost twice as much as it should have, and caused the loss of a great deal of valuable time. Also, the saving in engineering fees at the outset was insignificant compared to the engineering and legal fees that finally had to be paid.

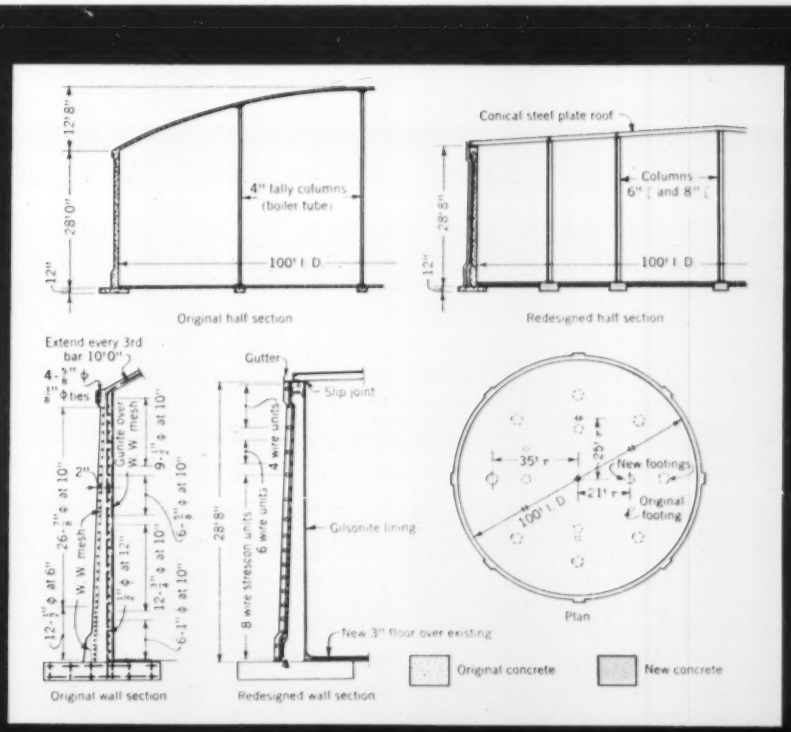
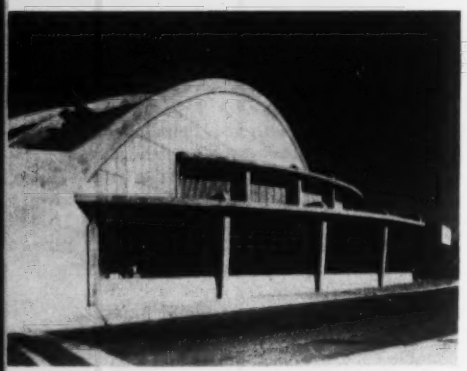


FIG. 1. Plan and cross sections for original and redesigned concrete tank show method used to rehabilitate 1,500,000-gal water storage reservoir. Redesign included addition of eight pilasters on outside to provide anchorage for 136 prestressed steel units covered by $^{7}/_{8}$ in. of gunite. On inside, Gilsonite mastic membrane was added to minimize leakage.

Curved main entrance (below) at east end is structurally independent and lent itself to attractive architectural treatment. Air view shows division of roof into six units, each consisting of three arch ribs and connecting shell, with double ribs where units meet. Note also enclosed overpass in right background which bridges 46th Avenue and connects with stockyard area, making it unnecessary to equip building with space for animal storage. Parking area for 2,300 cars was provided in rear by filling in pond with excavated material.



Thin-shell arch selected

Careful adaptation of structure to sloping site saves money

Denver's new coliseum, with its more than 8,000 permanent theater-type seats plus 3,600 temporary seats, was designed for maximum public use. It serves the area which Colorado people like to call the Rocky Mountain Empire, as an all-purpose arena for conventions, exhibits, educational and sports events, ice skating shows, and kindred uses. As it is also the home of the National Western Stock Show, it was located not far from existing stockyard facilities. This coliseum, which replaces an old stadium built in 1908, is in the north central section of the city, ten minutes from downtown Denver, between Brighton Boulevard and East 46th Avenue.

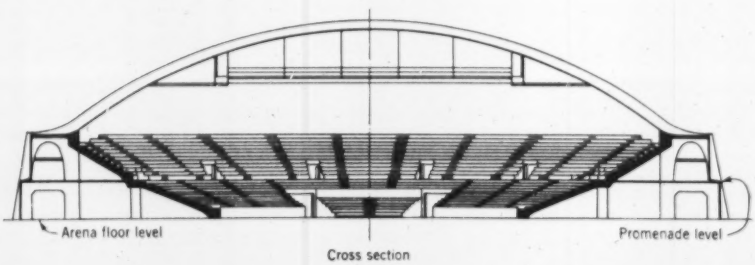
Financing was by a municipal bond issue ($1,500,000), city funds ($500,000) and private subscriptions ($700,000), and represents the achievement of a progressive city administration aided by a score of civic-minded Denver men. The land was donated by railroad, agricultural, livestock and packing interests—enterprises which represent nearly 50 percent of Colorado's income.

Available funds limited the size to 308 × 400 ft overall, restricted the lower-level floor to half of the building, required the use of decentralized heating instead of a central plant and also required the omission of all non-essential detail and finishes. An additional 1951 appropriation made possible the inclusion of a modern ice floor, elaborate-effect lighting and televising facilities.

The natural contours of the site, with a slope from east to west, suggested placing the bottom of the arena bowl 16 ft below the level of the street on the east side. Patrons entering from this side, through the main entrance and lobby, follow a promenade which encircles the building and thus approach their seats at a level about equidistant from the highest and lowest tiers. In the east portion, where the promenade area is at ground level, the concrete stepped seating could be cast directly on the ground, eliminating structural supports and forming at an appreciable saving. The promenade level, together with the areas under the upper banks of seats, affords generous space for exhibits, checkrooms, and other concessions.

On the west end, the arena floor is at drive-in level, so that arriving performers are separated from spectators on the promenade, one level above. Offices, dressing and equipment rooms, storage and mechanical facilities, are located on the lower level, which extends under the west half of the building.

The main arena floor, 127 × 233 ft, is



Cross section

FIG. 1. Coliseum, as seen in typical cross-section, is curved shell of 254-ft clear span, carried by arches spaced 28 ft on centers. Typical arch axis is curved to catenary form. Building is 308 × 400 ft. Arena is rectangular with curved ends.

Interior construction view shows, left to right, stair stringers in place for upper tiers of seats, precast bleachers partly erected, and graded soil ready to receive concrete for seating (near half of building is unexcavated under promenade level). In right foreground concrete plenum tunnel, which encircles arena, is under construction. Above, catwalk with lights, and air ducts for heating and air conditioning, are hung from roof.

for Denver Coliseum

ANTON TEDESKO, M. ASCE, Manager, Structural Department

Roberts and Schaefer Company

Chicago and New York

designed for a wide range of activities. Temporary seats can be placed there for concert-type performances. The 10-ft perimeter strip around the arena proper can be used for standing room, rodeo performers, or other purposes.

Tunnels provide access from the east lobby to the arena floor, and removable barriers permit separation of the flow of spectators as desired. There is a bandstand at the east end of the arena floor and cafeteria space in the northwest corner of the building. Press boxes and control rooms for the radio and television sound system are placed at midpoints of the arena on a level with the last bleacher row. Washroom facilities and phone booths are arranged in the four corners of the building, and on the mezzanines above are the heating and ventilating plants.

Functional planning together with the economic desirability of utilizing the natural topographic advantages, resulted in the decision to give the enclosing building an oval shape. The appearance of the glass-fronted east entrance was to be duplicated on the west by enclosed curved ramps serving the entrances there. However, for budgetary reasons, the west end was made straight, and stairs were substituted for the ramps. Stairs, requiring less space, provide exits toward the parking area and secondary entrances needing a minimum of operating personnel.

On the east end, the street carrying traffic from Brighton Boulevard intersects 46th Avenue at an angle wide enough to accept the curved lobby structure in a position permitting the original building location to be moved eastward, toward the street, about 50 ft to clear an unsuitable foundation area.

Preliminary planning included the preparation and pricing of alternate designs in different structural media, all providing an uninterrupted, single-span arena arrangement without columns or balconies. Economic studies were also made to determine the best use of the site. The natural ground surface was substantially higher than the level at which it seemed best to place the arena floor. In view of these conditions and studies the designers decided on the use of a relatively low centering to build a monolithic roof structure on leveled existing ground, the excavation for the bowl, subfloor, and basement area to be made afterwards. The considerable volume of excavated material thus made available was used to provide a parking area for 2,300 cars by filling in a pond in an old gravel pit west of the building.

When soundings indicated the presence of good gravel at a reasonable footing level, an arch-type structure became the logical choice. Reinforced concrete had delivery advantages at the time and obviously was economical for a structure predominantly in compression, in which formwork could be reused effectively for a number of similar construction units. The structural system is shown in Figs. 1 and 2.

For convenience in placing concrete, the roof structure is divided into 56-ft units. Each roof unit is carried by three arches each 20 in. wide and $4\frac{1}{2}$ ft deep. The shell slab varies in thickness from 4 in. at the crown to 5 in. at the springing line. The shell is 6 in. thick where it meets the arch ribs. Expansion joints are provided on 112-ft centers. Although the variable column lengths required design investigations of many individual arches, reinforcing and concrete sizes were standardized for ease in construction.

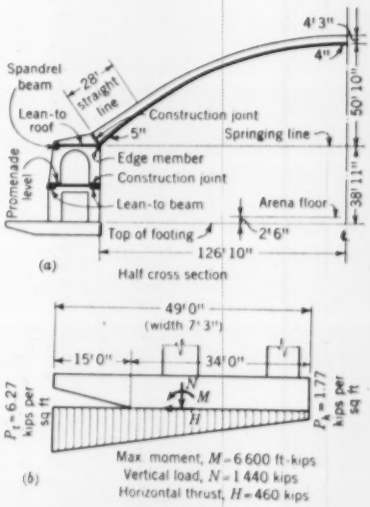
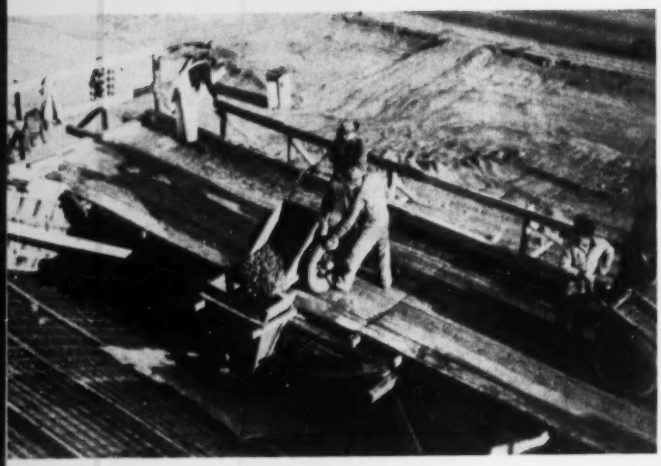


FIG. 2. Typical half cross-section, (*a*), indicates prime structural system. Arches are supported by heavy frames of 26-ft-wide lean-to wings, carried in turn by long narrow footings on dense sand and gravel. On lower level, open column frames are used in excavated west half of building, solid pedestals in unexcavated east half. Loads and soil pressure on 7-ft-wide arch footing are shown in (*b*).



Arch roof was constructed in six units each consisting of three ribs and connecting shell (upper photo). Low height of centering as compared with actual ceiling height was made possible by later excavation of arena bowl. Photo at left shows crane bucket dumping concrete into double hopper at leading edge of longitudinal runway. Buggies loaded there deliver shell concrete into short deflecting chutes (lower left) with tarpaulin below to protect reinforcing from spillage. Placing rate was 35 to 38 cu yd per hour.

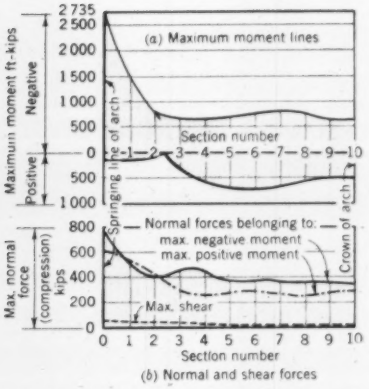


FIG. 3. Maximum design forces for arch ribs are indicated in (*a*), showing maximum moment lines, and in (*b*), showing normal and shear forces.

The roof system was designed for the dead load of the concrete plus the load of the roofing and acoustical cork insulation, plus a live load of 30 psf, which was assumed so as to result in maximum bending moment and thrust. Positive and negative pressure effects, based on a wind velocity of 100 mph, were included. However, wind loads with 50 percent increase of allowable stresses were not the governing condition. The effect of concrete shrinkage was taken equal to a temperature drop of 25 deg F. Temperature stresses were calculated for uniform changes of plus or minus 40 deg F, and for temperature variations within the structure of 30 deg F. The secondary stresses due to arch deflection, and the effect of rib shortening, were also calculated. The resulting arch forces are shown in Fig. 3.

The soil exploration method, employing rapid penetration tests at reasonable cost, gave accurate results such as usually are obtained only by more protracted boring procedures. (See "Foundation Exploration for the Denver Coliseum," Ralph B. Peck, ASCE Proceedings Separate 326.) A speedy determination of subsurface conditions was particularly helpful to the designers in locating the building so as to avoid the area of a long-abandoned smelter, as well as a deep fill of sand, straw, and manure cleaned from railroad stock cars. Knowledge of the soil conditions proved an important factor in dimensioning the primary structural system.

The great stiffness of the supporting frames permitted the use of slender arch ribs, which proved to be almost fully restrained. Decreasing the size of the buttresses and thus permitting less restraint at the springing line, would have meant increasing the size and weight of the arch, thereby increasing its cost. Decreasing footing movements by enlarging the foundations generally means additional foundation cost, which however may be justified by the greater rigidity of the arch supports.

The soil studies resulted in the prediction that the soil would compress 0.15 in. per 1,000 psf. Knowing the soil pressure on the arch footings, see Fig. 2(b), the settlement, translation, and rotation of the footings were predicted. Calculations indicated the amount of extra steel required in the superstructure to provide for movements in the foundations and thus made it possible to judge whether it was more economical to provide for extra strength in the arches or to reduce foundation movement by using lower pressures.

The adopted structure shows an economical balance between the saving in the cost of the arch compared to the expense of more rigid foundations. It proved advantageous from the standpoint of overall economy to limit footing rotations to an equivalent of 0.6 in. of differential settlement between toe and heel. The maximum measured differ-

ential dead-load settlement between toe and heel varied between 35 and 60 percent of this allowable value. The measured arch deflection in the crown of a typical arch-roof unit was about 1 in., which was close to the amount predicted.

Long rectangular arch footings had a cost advantage over shorter footings of T-shape or trapezoidal area. The footings had lengths of 48 and 49 ft. The 7-ft-wide end arch footing carries a vertical load of 1,440 kips, a horizontal thrust of 460 kips, and was designed for a maximum moment of 6,600 ft-kips. (See Fig. 2*b*.) The corresponding values for the 11-ft-wide interior footings are: vertical load 2,100 kips, horizontal thrust 635 kips, and moment 11,670 ft-kips. Long, narrow footings theoretically are the most economical under the given conditions.

Construction procedures for arch-shell structures, such as the Denver Coliseum, were described by the writer in CIVIL ENGINEERING for February 1953.

The contractor, accustomed to heavy bridge scaffolds, built the roof centering heavier than was considered necessary. The centering, consisting of ring-connected timbers, was made adjustable through screw jacks inserted between posts and curved trusses. The upper part of the centering, at jack level, was connected to the lower part by angle irons with slotted holes to provide rigidity during moving operations and to permit operation of the jacks. Jack manipulation was held to a minimum by the design of the roof, which provided a smooth ceiling without projecting members on the inside. Centering, on wheels running on angle-iron rails, was jacked forward and used six times. Such reuse often makes this type of structure possible where otherwise it would not be feasible. Design and construction features of a somewhat similar structure were described by Robert Zaborowski in CIVIL ENGINEERING for October 1951.

Concrete mixes varied with job conditions and the time of the year. A strength of 3,000 psi was required for most of the structural parts and 4,500 psi for the ice floor. These strengths were obtained with $5^1/_2$- to 6-bag mixes. For the roof, a 28-day strength of 3,750 psi was specified. A concrete yardage of approximately 390 cu yd within one day was required for each roof-placing operation above the springing line. A $6^1/_2$ or $6^3/_4$-bag mix gave, after 5 days, both the 2,500-psi strength and the 2,000,000-psi E-modulus required at decentering. The 28-day strength of the roof concrete ranged between 4,200 and 6,000 psi. This concrete was air entrained and averaged a $4^1/_2$-in. slump with 4 percent air. The entire project, including paving, required about 14,500 cu yd of concrete and over 1,300 tons of reinforcing steel.

Exterior walls between arch buttresses at promenade level, were designed as serrated concrete panels, with vertical gaps for windows. The wall panels, 6 in. thick, 7 ft 4 in. wide, and 18 ft high, could have been cast on the finished floor of the promenade and tilted up. Instead, the contractor chose to cast them in a yard west of the structure and to place them individually by crane. The end bays of the side walls, the basement walls, and the panels of the west wall were concreted in place.

Independent seating support

The seating construction is independent of the roof and promenade structure. The bleacher slabs in the east half of the building were cast in place directly on the ground. Where the bleacher construction is freely supporting, the contractor had the choice of concreting in place or precasting. He chose a combination—columns, stringers, and beam bands were concreted in place and bleacher units were precast. The precast units—beams of L-shaped cross section—lent themselves to repeated form use in a casting yard where concrete was placed whenever the concreting crew was not otherwise occupied. The units were then erected during the bad-weather months within the closed-in structure.

The erection procedure chosen by the contractor proved economical except for the uppermost bleacher tiers, which could not be reached with ease from the arena floor with the crane that happened to be available. Several precast units in the upper areas were broken during erection and were later replaced by expensive cast-in-place operations.

The seating structure is provided with contraction joints. The two-way slab system of the promenade is divided by joints at four-bay intervals, like the roof structure. Promenade floor and end wall have an expansion joint at the building axis. It has been the experience on other jobs that a curved expansion joint between the solid end wall of an arch structure and a freely supported roof arch is seldom satisfactory. Therefore the designers avoided such a joint by dividing the end wall horizontally at the level of the top bleachers. Above this level the curtain walls are of corrugated cement asbestos, insulated, on light steel framing hung from the arch structure above. The lower part of the end wall is of architectural concrete. Pin connections between concrete wall and steel framing permit vertical movement as well as the transfer of horizontal wind forces.

Ice rink and plenum tunnel

The ice rink is used for public skating, for hockey, and for ice skating shows. The refrigerated area consists of a 6-in. floating reinforced concrete floor which is separated by 4 in. of insulation from the 5-in. concrete subfloor. The skating area, 86 × 218 ft, is bisected by a $5^1/_2 \times 6^1/_2$-ft service tunnel containing the brine supply and return mains. This central location of the mains was economical as it cut the required runs for the brine lines, which consist of 1-in.-diameter wrought-iron pipe, spaced at 4-in. centers throughout the floor. The equipment is of sufficient capacity to freeze the floor in 15 hours, and by reverse circulation the ice can be melted rapidly. Steam-heated ice-removal pits are arranged alongside the rink.

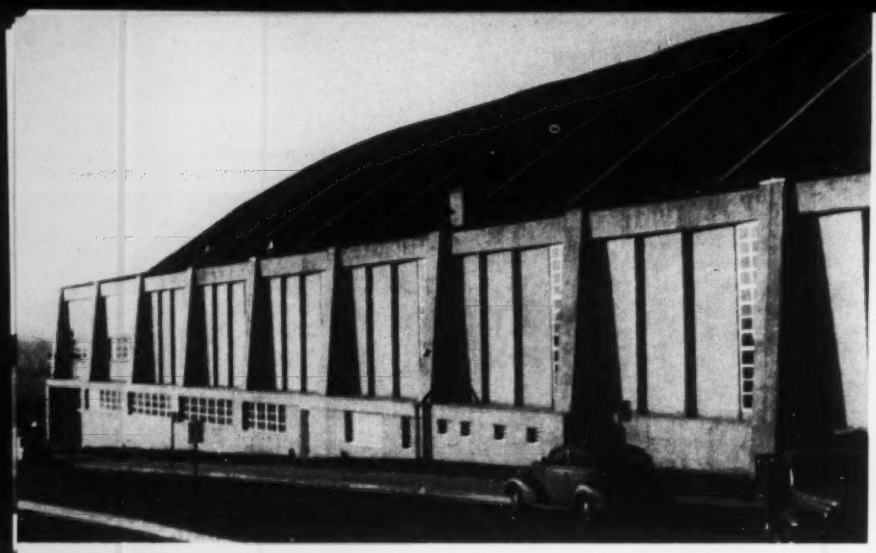
The plenum tunnel surrounding the arena floor houses services such as electrical, gas and steam outlets, and the controls for the floor freezing equipment. It also acts as a low-level air exhaust duct.

The coliseum is air-conditioned, air being supplied at high level through ducting and diffusers from four central plants located at each corner, under the roof. The plants are gas heated to furnish a total of 300,000 cu ft of warm air per minute; each has a capacity of 4,500,000 Btu per hour. Well water is the cooling medium in summer. Two independent exhaust ventilation systems are provided, one operating through the arena floor plenum (with a capacity of 210,000 cfm) to prevent "fogging" during rodeo shows, when tan-bark dust rises from the floor; the other (with a capacity of 180,000 cfm) is a high-level exhaust for use during most other types of performances.

Arena lighting is designed for flexibility, to take care of any use of the building visualized. Catwalks carrying 1,500-watt spot and floodlights are suspended from the roof, longitudinally and transversely. Elaborate-effect lighting is arranged on structural rigs which can be raised and lowered. Electrical supply is from four substations, each of 300-kw capacity, at the corners of the building. Communications, paging, and loud-speaker systems are furnished throughout the building.

Shops, boiler room, refrigeration equipment, transformers, and control rooms for heating, ventilating, and air conditioning are located in the south basement area, near the center of the building, where access to the pipe tunnel under the floor of the arena is provided. Comprehensive fire protection in the form of standpipes, sprinklers, etc., is furnished.

The owners placed emphasis on permanence and believed that future main-



Side wall, between arch buttresses at promenade level, consists of serrated concrete panels and vertical window gaps. Inside view of same wall shows attractive archways through buttresses, which permit promenade to completely circle building, about equidistant from highest and lowest tiers of seats.

tenance and operating costs should be kept low even at the expense of increased first cost. This philosophy applied not only to the structure but also to mechanical items and standby equipment, which were chosen to get the benefit of lower gas and electric rates.

Contract costs

Separate contracts were let for the main features of the work in 1949 and 1950, based on modified low bids as follows:

General construction (Swinerton & Walberg, San Francisco)	$1,340,000*
Plumbing, heating, fire-protection, ventilating (Denver Plumbing & Heating Co.)	389,000
Electrical work (Sturgeon Electric Co.)	276,000
Ice rink, refrigeration, air conditioning (McCarthy-Johnson Co.)	131,000
Seating and portable chairs	96,000
Wells	18,000
	$2,250,000

* Original low bid of $1,275,000 did not include tunnel, pits, etc., required for ice rink

This total for the fully equipped building does not include outside work done by the city, such as grading, parking area, and outside utilities, which make up the difference between the above total and the total of all available funds.

Costs for 1954 should not exceed these figures by more than 10 percent.

With separate contracts like these, it may be questioned whether the added costs due to the ensuing system of divided responsibilities and management do not outweigh the savings, such as tax advantages and the absence of the "mark-up" by the general contractor.

The contract for the general construction represents a cost of about $11 per sq ft of plan area (omitting the ice rink), or $160 per permanent seat ($110 per chair for the maximum seating capacity). This is less than 20 cents per cu ft for the structure. The fully equipped building represents a cost of $20 per sq ft of building plan area, $13 per sq ft of usable floor space, and 34 cents per cu ft. Costs per seat become $282 and $195 respectively.

Claims have been made that the building is of insufficient size for rapidly growing Denver. The designers agree that for one week of the year—during the stock show—it would be good to have a larger building. However, it would have been unsound economically to base the size of the structure on the seven best selling evenings of the year. The maximum occupancy for events during the rest of the past year has consistently been between 4,000 and 4,500. Denver's metropolitan area at present has a population of 565,000 and the forecast for 1970 is 819,000. Even at this rate of growth, the capacity of the coliseum, except for a few peak evenings, may be considered adequate for some time to come.

Ground was broken late in the fall of 1949, but construction was stopped by a strike during most of the summer of 1950, so that the structure was not formally dedicated until the January 1952 annual stock show.

Quigg Newton is mayor of the City and County of Denver. Denver's planning director, W. F. Henninger, made the city's decisions during the design stage and directed the award of contracts. During the construction stage, Terry Owens was city engineer; Richard Bennetts, construction engineer for the city, was in charge of coordination and inspection.

Roberts & Schaefer Company were retained by the city for overall design and supervision. Associated consultants were Lorimer & Rose, architects of New York, and Roland L. Linder, resident architect of Denver. Slocum & Fuller were the consulting mechanical engineers. Ralph B. Peck, M.ASCE, was foundation consultant.

Roberts & Schaefer Company was responsible for engineer-architect planning, the taking of bids, and the general supervision of construction—phases not handled by the city staff. The writer was in charge of the work for the company.

Arena is ready for a performance, with temporary seats in place along sides and near end. Below row of fixed spotlights at right are platforms for individual carbon-arc spots with aluminum access ladders lowered. Electrically operated score board is on far wall, under clock.

(This article includes material presented by Dr. Tedesko as a prepared discussion at the Denver ASCE Convention, June 1952, before a session of the Soil Mechanics and Foundations Division presided over by Robert F. Blanks, chairman of the Division's Executive Committee.)

Forced to join a union?

It can happen to you

L. STEWART McCOY, J. M. ASCE

Terry & Wright, Inc., Louisville, Ky.

Less than a year ago I attended a dinner meeting of engineers in Cincinnati where the pros and cons of collective bargaining were discussed. I was not particularly interested and soon forgot what was said. My belief always had been that a professional bargaining group is undesirable, but that, on occasion, one may be necessary or, conceivably, desirable. I believed that I had no need to listen to further debate on the subject.

Then, last December 3rd, I suddenly learned many things about unions, engineers, and collective bargaining. Without much doubt other engineers will find themselves in a similar position very soon. It can happen to you.

My employer, the contracting firm of Terry & Wright, Inc., of Louisville, Ky., was the low bidder on the construction of a 12-mile section of the Ohio Turnpike west of Toledo. In July of 1953, I was transferred to that area and began setting up plant and doing some layout work.

In September our general superintendent told me of a rumor he had heard to the effect that the International Union of Operating Engineers—the equipment operators' union—planned to organize all engineering field parties on the Turnpike. We had a good laugh. The reasoning behind the proposal was as absurd as the idea, namely, that it would be inconsistent for a union operator to grade to stakes set by non-union engineers. However we soon found this to be not a rumor but a fact, and not at all humorous. In October officials of the IUOE asked my company to have me join their union. They were told to sign me up themselves. I was informed of the incident and stated my opposition even to discussing the matter. Later, when the organizer came to the project, he was informed that I had no desire to discuss the matter with him. He left without seeing me. For a time the matter seemed to have been forgotten.

Then, late on December 3, one of the members of our firm telephoned from Louisville. He informed me of an ultimatum he had received from the IUOE stating that unless they were given the civil engineering on our job they would call all their men off, effective immediately. I explained how I felt about the situation and told him that under no circumstance could I join the union.

When the other member of the firm, a civil engineer himself, learned of the force play by the union, in direct violation of our contract with the operators, he was determined to support my stand. We could find no other contractor who had been put in this position. We knew of no other contractor who was using IUOE layout parties even though the union claimed we were the only turnpike contractor who had not met its demands. Our general superintendent was instructed to call the union office in Cleveland immediately and refuse to force me to join the union. This he did. By 10:00 p.m. the same day the union steward had instructed the night shift not to return to work. That same evening, the 3rd, I notified the Toledo Section of the ASCE and the Ohio Society of Professional Engineers of my situation and requested instruction and support.

The strike became effective the next day, Friday, December 4. The action seemed so fantastic that IUOE members on our job would not believe their union would do such a thing. However, their steward assured them that it had. The men were disgusted with the actions of their own union bosses and threatened to break the strike themselves. The following Monday a number of operators assembled for work in violation of orders. They were stopped only by the threat of having their union cards withdrawn. Terry & Wright appealed to the Ohio Contractors Association for support. The OCA replied that this was a fight between the civil engineers and the IUOE, and that their position would only be that of an interested observer. My company realized that it could not combat the union without help, and as far as the civil engineers were concerned, they could put up but a feeble fight against the power of a strong labor organization. It was apparent that the first encounter must end in surrender to the union.

Union demands met

On December 8 we met with representatives of the IUOE in Toledo. Their demand was the same. We accepted with reluctance and work was resumed the following day. Now our field party men on the project must belong to the IUOE in order to work. Inasmuch as I would not join the union, I was no longer permitted to perform field work as my employer had intended.

The strike was short and affected less than three hundred men. But it was an important strike. The result has indicated to me that contractors prefer engineers who are willing to think and bargain for themselves, and will aid them in a fight to keep engineering on a plane above that of a craft—provided that the engineers themselves so desire.

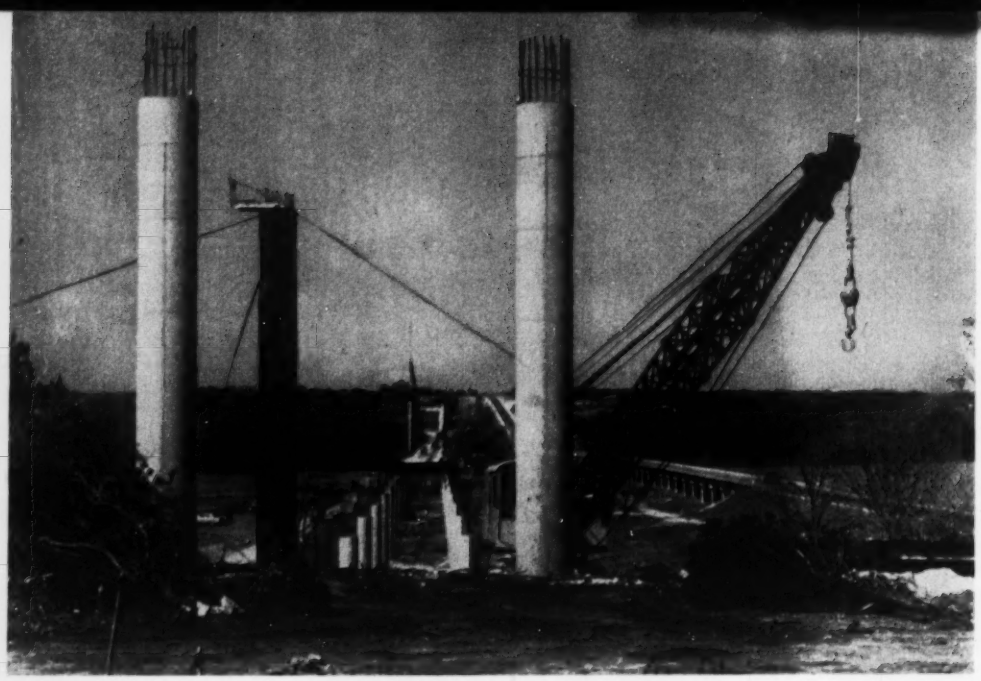
The strike further demonstrated to the engineering societies a need for positive action. It brought to public notice the fact that the IUOE is not above adopting any available means to force its will on individuals or groups. If all self-respecting engineers would withdraw their membership from unions, the result could serve to unite us in a common cause which would strengthen the profession. It is evident that some forceful policy must be developed. The direction in which we must turn is not yet entirely clear. But one thing is certain—the profession must have a strong policy regarding labor unionism and must support this policy 100 percent. Polite rebuke is not enough.

Although my first encounter with labor unions was lost, I have not given up. Suit has been filed on my behalf against the IUOE on the basis of unfair labor practice. The outcome of this action is in the hands of the court.

The problem is serious. The union aims seem clear. IUOE is not interested just in the engineers employed by contractors. This is the first step in an ambitious plan to control all construction. I envision that the program may be conducted about as follows.

First, they will seek to take over the contractors' field parties because force can be exerted against the contractors. Next, they will insist that a union field party cannot work in conjunction with a non-union field party furnished by the consulting engineer for a project. The consultant, to protect his client, must give in to the demand for unionizing his field party. Next in order, we will find that since the lines on the drawings are not those of union draftsmen, nor the thoughts and calculations those of union engineers, construction becomes a violation of union policy. Hence the project cannot be built. If that seems farfetched to you, I suggest that you give

(Continued on page 102)



Steel forms were used for bent legs, and no rubbing of concrete was required. At top of formed shaft, note platform for men dumping concrete bucket. Ladder up side was made by welding steel bars to form. For capping bents, safety platform made of bar joists, and equipped with handrail, was clamped to columns. Weight of platform and cap forms was supported by heavy steel straps around columns.

Fixed bents for Texas highway bridge

RANDLE B. ALEXANDER, A. M. ASCE

Bridge Engineer, Texas Highway Department, Austin, Tex.

An unusual design was developed for the bridge just completed to carry Texas State Highway 36 across Belton Reservoir, to be impounded by Belton Dam, now under construction by the Army Corps of Engineers. Because of the height of the bents, it was found economical to make every bent fixed. The entire bridge superstructure is tied together so that a load at any point will be transmitted throughout the bridge. The main design element is a 5-span continuous I-beam unit with each of the spans 80 ft long (Fig. 1). In addition, there is a cantilevered section beyond the main element attached to the next unit with suspender bars which transmit shear across the joint without carrying moment, and with provision for expansion through finger joints.

Belton Dam, on the Leon River near Belton, Tex., is a part of the flood control and conservation program of the Corps of Engineers for the Brazos River watershed. When the dam is completed, the existing bridge at this location, which was built in 1947, will be inundated. This important highway cannot be closed and cannot be relocated around the reservoir. Therefore, under existing laws, the Texas Highway Department entered into a contract with the Corps of Engineers to prepare designs and specifications for a new bridge to carry the highway across Belton Reservoir.

The Highway Department let the contract for building the bridge and supervised its construction. This contract provided that the bridge be designed for H-20 loading, have a 26-ft roadway and 18-in.-wide curbs. To provide adequate safety for the bridge, the finished floor level was established at El. 636.0, which is 5 ft above the spillway elevation. This gives the bridge a height of about 92 ft above the bed of the river.

The bridge was located 170 ft downstream from the existing bridge so that construction would not interfere with highway traffic. At the new crossing the lowest point in the channel is El. 544.4 and the general elevation of the river bottom is about 570.

Leon River Bridge is seen completed, also old highway and bridge paralleling it (at right) about 170 ft upstream. New structure carries two traffic lanes in each direction plus walkway on each side.

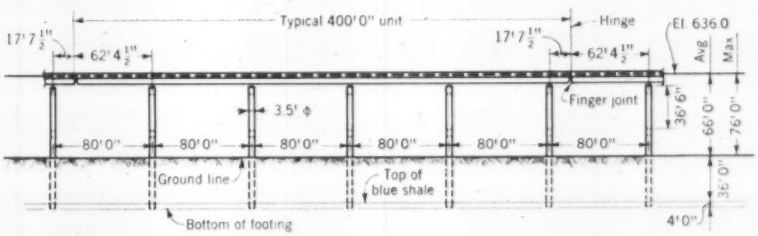
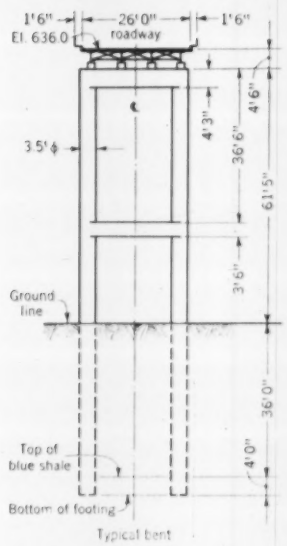


FIG. 1. Typical bent has drilled shafts extending about 40 ft below ground surface, lowest 4 ft being through hard blue shale. No belling at bottom was necessary in this material. Five bents are tied together in 400-ft units.



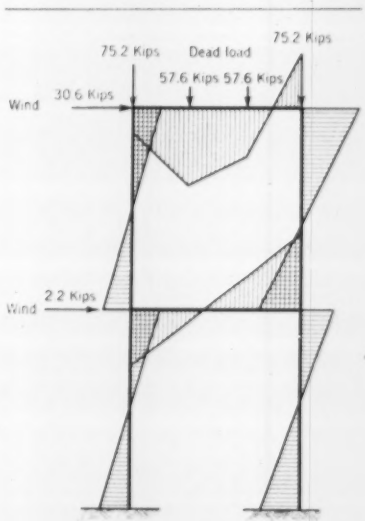


FIG. 2. Moment diagrams show dead load plus lateral wind load on a typical bent.

The economic bridge length was determined by comparing the bridge cost per foot with the cost per foot of the earth-fill approaches, including pavement, guard railing, and riprap protection to El. 631.0, the spillway elevation. It was found that the cost of a fill about 34 ft high was equal to the bridge cost. On this basis the bridge length was determined from the profile to be about 3,680 ft. On the approaches the finished embankment width at the crown was made 46 ft to provide a feeling of security because of the height of the fill.

With the bridge length determined, the next problem was the economic studies to determine the span length and type of bent. Foundation exploration indicated a hard blue shale about 40 ft below the ground surface. The safe bearing capacity of this shale was determined, from unconfined compression tests on cores, to be 21 tons per sq ft. This is the same material into which the reinforced concrete piles supporting the old bridge were driven. The drilled-shaft type of foundation has been developed to a high state of usefulness in Texas, largely through the efforts of several contractors who appear to vie

with one another in developing machines and procedures for giving the engineers what they want in foundations. Some of the machines are adaptations from oil-well drilling equipment, and some of the contractors use a heavy oil-well drilling mud in their drilling operations to hold back soft materials until the casing can be set.

Several types of bents were investigated, including tower A-frames for fixed bents, rectangular tower fixed bents and fixed bents of battered column type. It was decided to use the bents shown in Fig. 1, with the following arrangement, beginning at the east end:

1 continuous I-beam unit about 418 ft long (5 spans 80 ft long plus 18-ft cantilever arm)

7 continuous I-beam units 400 ft long (5 spans 80 ft long)

1 continuous I-beam unit about 462 ft long (5 spans each 80 ft long plus 62-ft cantilever arm)

Bent legs were to be drilled into the shale, but an alternate was provided for footings supported by 15-in.-square precast concrete foundation piles. The contract was awarded on the basis of lower bids for drilled-shaft foundations than for pile-supported bents.

The equipment which the contractor used to drill the shafts into the shale is shown in an accompanying photograph. In drilling, rotary motion is transmitted, by a system of chains and gears, to the square bar, or "Kelly bar," suspended from the tip of the boom. Attached to the lower end of the "Kelly bar" is a digging bucket with a cutting edge on its bottom. This bucket is rotated until filled with cuttings. It is then hoisted out of the hole, emptied by dropping the hinged bottom and returned to the hole for another load. When the shale is reached, the casing is set and seated in the shale by rotating. Serrations on the bottom edge of the casing assist in seating the casing.

In poorer materials than those encountered here, it is the practice to bell out the hole to increase the bearing area. This is done with ingenious buckets with retractable blades or, in some cases, by hand. Since the material at this site had excellent bearing capacity, no belling was necessary. The shafts were carried into the shale a minimum of 4 ft, and small exploratory holes were drilled below the footings to insure against founding on a thin layer of hard material or over a cavity.

When the hole had been cleaned out, the steel reinforcing cage was set in the shaft and concreting began. As soon as sufficient concrete had been placed to overcome the hydrostatic head existing at that hole, casing pulling operations were started. It might require the pull of both dragline machines to move the casing, but once it was started, one machine usually could bring it out of the hole. The bond between the casing and the newly placed concrete must be broken as soon as possible. A small movement will keep more bond from being developed, and the hole may be filled nearly to the top before the casing is entirely removed.

Most contractors prefer to use a short form just about at ground level, to which the above-ground shaft forms can be attached. Because of the depth to the shale and the length of casing required for each hole drilled, progress was a little better than one completed shaft per working day.

Steel forms were used for the bent legs and no rubbing of the concrete was specified, nor was it found necessary.

Since it was found advisable to make every bent fixed, it was necessary to provide for longitudinal expansion at locations other than at bents. Placing expansion joints at locations other than at bents made a load in any one span of a unit affect all the other spans in the unit because the spans are continuous for four spans and cantilevered beyond for a shear connection with the next unit, as shown in Fig. 1.

The design analysis for the superstructure was an adaptation of moment distribution. Unit moments were introduced each side of each support and distributed until the effect was negligible. Influence lines were then calculated in only those spans where they would be helpful. Column analogy was used to determine the true stiffness and carry-over factors. The factors of the hinged spans were calculated in the same manner as for the other spans except that the center of gravity of the analogous column is at a pin (analogous column width is infinite at a pin). Moments for dead load and full wind load on a typical bent are shown in Fig. 2.

Since this bridge is so high, and since it is expected that many people may want to view the lake from the bridge, a special railing was designed to safeguard pedestrians.

This bridge was designed by the Bridge Division of the Texas Highway Department. The contract for its construction was awarded to the Dean Word Company of New Braunfels, Tex., July 7, 1952 and was completed in March 1954. The contract amount for the bridge and approaches was $1,014,034. The construction was under the direction of District Engineers D. M. Puckett and Thomas C. Collier, with Joe T. Brown as Senior Resident Engineer.

Contractor's drilling equipment is seen at work on drilled-shaft foundations. Auger used in top part of hole stands behind right-hand machine, which has drilling equipment attached in front. When shale is reached, casing is set and seated by rotating it.

THOMAS C. OFTELIE

Assistant Chief Engineer,

Aero Service Corporation,

Philadelphia, Pa.

Problems of 2-meter contouring are readily apparent in air view of representative topography in Cerro Bolivar area.

Jungle no barrier to aerial mappers of Cerro Bolivar

Previous reports on the Cerro Bolivar iron ore region of Venezuela have given credit to photogrammetry for aid in its discovery. Other contributions made by photogrammetry and aerial photography in the exploration and development of this mineral deposit are equally important.

In 1946, a small group of Oliver Iron Mining Company geologists and engineers, headed by Mack C. Lake, who later became the first president of the Orinoco Mining Company, were faced with the problem of examining all iron formations in a vast region south of the Orinoco River. This region was approximately the size and shape of the states of Massachusetts, Connecticut, and Rhode Island. Existing maps and charts of the area were small scale and so inaccurate that they were useless for this exploration. Lake sent his field parties first to locations of known or suspected iron-formation outcrops occurring at relatively short distances from the south bank of the Orinoco. These parties made remarkable progress through the dense rain forests of the El Pao, La Grulla, and Piacoa regions, with nothing better than compass traverse to control their geological mapping. However, Lake and his geologists knew that fast, accurate knowledge of the topography of the whole area must be obtained if the exploration was to continue on schedule. To this end, Fairchild Aerial Surveys, Inc., was engaged to fly 1:40,000-scale aerial photography of about 11,000 square miles.

A photo mosaic of this photography was prepared using scattered astro positions to control the radial triangulation plot. Planimetric features such as drainage patterns, trails and ranch houses were traced from these mosaics, thus furnishing a relatively accurate map at a usable scale in a very short time. For planning, a small-scale mosaic of the entire area was also compiled. This work was started late in 1946 and completed at the close of the dry season in 1947.

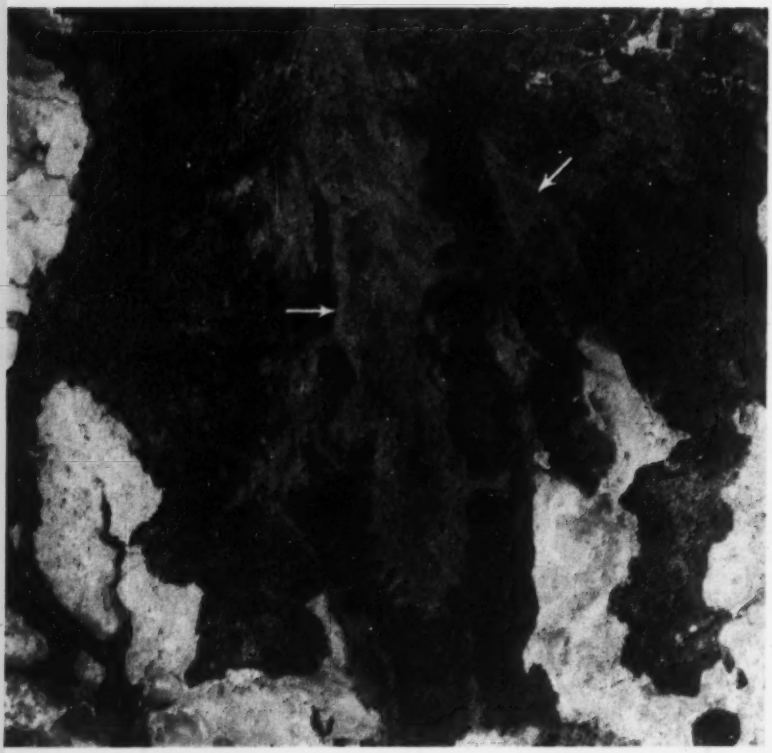
While this photography and mosaic work was in progress, Lake's investigations continued. At this time, F. H. Kihlstedt was resident manager of the exploration. H. C. Burrell (now deceased) was chief geologist and F. W. Wright, Jr., his assistant. As photographs of the more remote regions became available, they were eagerly studied by the geologists. Kihlstedt noticed the landslides of the mountain while examining a stereo pair of photographs. He suspected that they were caused by the leeching of silicon from iron-rich rocks, and his field investigations uncovering Cerro Bolivar more than verified his suspicions.

Extent of ore determined

Perhaps the most remarkable use of the aerial photos was their great value in accurately determining the extent of the ore bodies. Kihlstedt, Burrell and Wright were quick to notice that the vegetation covering the ore body on Cerro Bolivar has a distinctive texture on the aerial photos. This vegetation, a variety of the copei tree, helped to delineate the surface extent of the ore body because it is the only type of tree or bush which thrives on the soil produced by the iron ore. This was an important discovery for the steel corporation since there was a limit to the claims one company could stake. However, Kihlstedt and his aides, with their faith in the copie-tree method of delineation, were able to lay out the U. S. Steel claims with great efficiency and speed.

The planimetric overlays of the mosaics proved very useful as preliminary base maps but it was quickly realized that their usefulness would be greatly increased by the addition of topographic form lines. This was done under Wright's direction by drawing the form lines in white shoe polish—the only readily available material—directly on the contact prints with aid of a hand stereoscope. The lines were then traced on the mosiac overlays with a small reflection projector. The resulting maps were most satisfactory for preliminary planning, route studies, and land acquisition, and the maps were produced with a minimum of expensive ground-control surveys.

Land acquisition was a real problem because increased land values made the old, vague, and indefinite boundary lines very important to the Venezuelan land owners. Aerial photography provided a quick solution to the problem. The land surrounding the Cerro Bolivar-Altamira-Airimugua Cordillera is mostly



Distinctive texture of areas covered by copei tree helped to delineate ore body from air. This tree is only type of vegetation that thrives on soil produced by the iron ore.

Form lines on air photo are drawn in white ink. In the field, in Venezuela, white shoe polish was used because it was quickly available. Addition of these lines enhanced value of planimetric overlays and sped preliminary route planning.

tropical savannah with patches of rain forest along major streams and on the slopes of the mountains. It has been used for cattle grazing for centuries. The ranchers of the area had never needed more than a general idea of their holdings until the land suddenly became valuable. The resulting claims and counter claims concerning land boundaries might never have been amicably settled without the aerial photographs. Agreement was reached when a line drawn across recognizable features on an aerial picture connected with boundary markers previously agreed to by all parties to the dispute. It was easy also for company representatives to prove the accuracy of the form-line maps by on-the-spot comparison with a photograph of the same area.

The initial reconnaissance survey of the Orinoco River to determine which, if any, of the several caños (branches of the river) in the delta region was suitable for development, has been described by Walter H. Gahagen in his article on the dredging operations for the project in the December 1953 issue of CIVIL ENGINEERING. An interesting detail of this survey is the way aerial photographs were used to provide control for the soundings. A member of the Gahagen survey party stood on the foredeck of the sounding launch with a series of 9 × 9-in. contact photos in hand. As the launch passed identifiable features, he marked the photo and signaled the echo-sounder operator, who recorded a fiducial line across the sounding tape. This quick control enabled the Gahagen engineers to produce rough estimates which thorough mapping and dredging verified later.

Drilling and tunneling operations were started on Cerro Bolivar as soon as possible after its discovery. A hasty, fourth-order triangulation net was established in the area, and cross-section lines 200 meters apart were laid out at right angles to the long axis of the mountain to provide control for these operations. Geologists traversed the cross-sections with Brunton compasses and tapes, mapping detailed geologic information which was plotted on the profiles thus obtained.

Aerial maps with 5-meter contours

The need for more accurate topography of the area was acute, and as the drilling and detailed surface geology studies gave increasing evidence of the importance of the find, it became necessary to prepare photogrammetric maps from the aerial photographs taken in 1947. The photography had been flown at an altitude which would permit compilation of 1:5000-scale maps with 5-meter contours. A vertical datum was established at the camp site by daily ob-

servations of barometric elevations for a period of one month. Vertical angles observed at the time of the triangulation survey were used to obtain trigonometric elevations based on this datum throughout the net. The points where additional control was necessary for the photogrammetric compilation were indicated and the net was extended to include this control by the surveyors.

The 1:5000 series maps of Cerro Bolivar proved very successful for the exploration drilling and initial planning stages of the mine development. Therefore it was decided to extend the same series roughly another 90 miles to the confluence of the Orinoco and Caroni Rivers along the newly selected haulage route using the same photography. A wide band of topography was to be mapped and several alternate routes included. This permitted paper locations of the alternate haulage routes and cost comparisons of each route to be made prior to actually staking a preliminary location.

The air survey company provided two field men to put in a third-order triangulation net along the proposed routes, and it also prepared a Lambert grid for the mapping, using astro stations tied to the triangulation at the mine and at the proposed river terminal. Vertical-angle elevations were carried through the net using the Cerro Bolivar datum. At the river end of the line, elevations were tied to a gage at the Palua ore docks of Bethlehem Steel's El Pao development. The vertical equation between the Cerro Bolivar and Palua datums was approximately 13 meters.

These maps were available for laying out paper locations for the haulage routes during the early summer of 1950. Field parties under the direction of G. L. Link, formerly locating engineer of the C. & O. Railroad, started staking the location in July 1950, proceeding from the river terminal towards the mine. The preliminary line of 145 km was completed in January 1951. While 5-meter contours are generally considered inadequate in location work, it was decided to make use of existing photography to save time. In this instance, 5-meter contours were satisfactory because of the gently rolling and choppy terrain. Moreover, there were no right-of-way problems. The adequacy of the 5-meter maps in this instance was demonstrated by the fact that trackage was finally laid without major changes in the line as originally staked.

A roadway location was staked at the same time so that the camp established for the rail field parties could be utilized with consequent savings in time and costs. Here the advantages of photogrammetric mapping methods, which permit mapping relatively wide bands of terrain quickly and at low cost, were very evident. The wide bands of topography available permitted selection of a more direct route for the road where less severe grade limitations prevailed.

While the location surveys for these routes were in progress, expanded drilling and tunneling programs were under way at the mine. The aim of these programs was to "block in" the ore body and obtain detailed information essential to properly plan the mining operations of the future. The earlier exploration drilling was primarily designed to prove up the ore body. Now the inaccuracies of the early fourth-order triangulation became serious, and plans were made to install a new second-order triangulation and bench-level net for the entire Cerro Bolivar area. This new control net was installed during the dry season of 1951 and 1952. All positions and elevations were adjusted by the method of least squares, and all drill holes and other important locations were resurveyed and coordinated with the new control.

For the detailed mine planning, the Orinoco Mining Company let a contract to Aero Service Corporation, in March 1952, to refly the Cerro Bolivar-Atamira-Arumagua Cordillera at a lower altitude to permit compilation of 2-meter contour maps at a scale of 1:1000. Before the photography was taken, all control monuments were marked with sheets of corrugated aluminum so that they would be easily identified on the photographs.

Aero supplied one field man to make the photo identities and to run in approximately 15 additional vertical photo-points required for the map compilation. The completed maps were delivered in August 1952. Conventional ground methods of mapping the same area would have required at least a full year longer and would have cost over ten times as much.

Photogrammetry has thus aided the development of this ore mining project in the following four ways:

1. Discovery and delineation of the ore bodies.
2. Rapid preparation of base maps which were used for land acquisition and the early planning stages.
3. Control of preliminary estimates for dredging the Orinoco River.
4. Speeding the topographic mapping essential for route locations and detailed mining plans.

(This article has been prepared from the paper presented by Mr. Oltelie at ASCE's Atlantic City Convention, before the session of the Surveying and Mapping Division, presided over by R. H. Lyddan, Chairman of the Division's Executive Committee.)

Pilot and photographer check over glossy print of flight strip before take-off for day's work in twin-engined Beechcraft used for surveys in Venezuela.

USS Missouri is snapped from air passing through Panama Canal lock—a tight squeeze Pas sage was made without mishap although it is no easy job to maneuver giant ship through Miraflores Locks.

The Panama Canal problem

Half a dozen years ago ASCE devoted an Annual Convention and 300 pages of Transactions (Vol. 114, 1949) to a symposium on the Sea-Level Project for the Panama Canal. Since that time the matter has been largely dormant. HR 1048, 83rd Congress, provides for the creation of an impartial body of nine men, an Interoceanic Canals Commission, to make a constructive study of the problem of improving the capacity of the Canal and to recommend a comprehensive policy. The statement which follows was prepared for the information of Congress and expresses the considered judgment of those whose names appear at right, all of whom have, in various capacities, participated in the construction of the Panama Canal.

James T. B. Bowles, Baltimore, Md.
Ralph Budd, Hon.M.ASCE, Chicago, Ill.
Howard T. Critchlow, M.ASCE, Trenton, N.J.
Roy W. Hebard, New York, N.Y.
Herbert D. Hinman, Newport News, Va.
William R. McCann, M.ASCE, Hopewell, Va.
E. Sydney Randolph, M.ASCE, Baton Rouge, La.
Hartley Rowe, Boston, Mass.
William E. Russell, New York, N.Y.
Caleb Mills Saville, M.ASCE, Hartford, Conn.
John Frank Stevens, Brooklyn, N.Y.
Ellis D. Stillwell, Monrovia, Calif.
William G. B. Thompson, M.ASCE, New Haven, Conn.
Robert E. Wood, Lake Forest, Ill.
Daniel E. Wright, St. Petersburg, Fla.

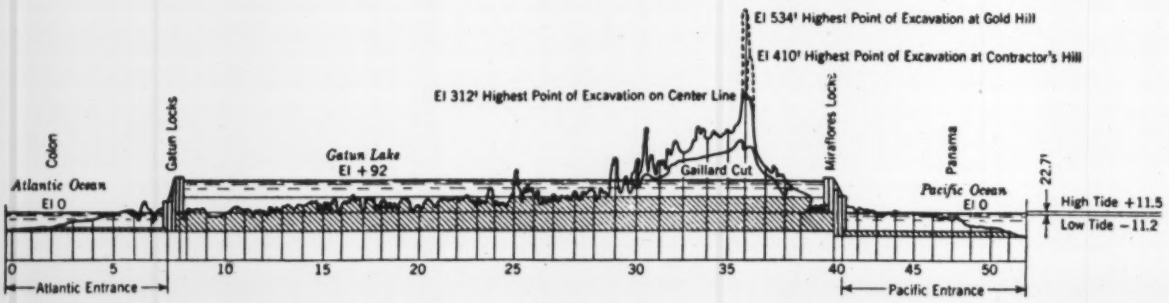
The necessity for increased capacity and operational improvement of the Panama Canal—a much-neglected waterway, now approaching obsolescence — has been long recognized. The traffic volume is the highest since 1914. With the saturation point approaching, it is essential to provide, without further delay, the additional transit capacity and operational improvements required to meet future needs.

The two major proposals for increased facilities are:

1. Improvement of the existing canal by completing the authorized Third Locks Project, adapted to include the features of the well-conceived Terminal Lake Plan (Congressional Record, April 21, 1948, p. A2449—approved in principle by the [then] Governor of the Panama Canal in hearings on H.R. 4480, 79th Congress, Nov. 15, 1945, p. 9). A total of $75,000,000 was expended on this project, mainly on lock-site excavations at Gatun and Miraflores, before work on it was suspended. The Terminal Lake Plan provides for removing all lock structures from Pedro Miguel and for regrouping of all Pacific locks at or near Miraflores, thus enabling uninterrupted navigation at the Gatun Lake level between the Atlantic and Pacific locks, with a greatly needed terminal lake anchorage at the Pacific end of the canal. As thus improved, the modified Third Locks Project can be completed at relatively low cost—estimated at under $600,000,000. The soundness of this proposal has been established by 40 years of satisfactory operation of a similar arrangement at Gatun.

2. Construction of a practically new Panama Canal known as the Sea-Level Project, initially estimated in 1947 to cost $2,500,000,000, and which would be of less operational value than the existing canal it was designed to replace, but which, under present conditions, would likely cost several times that amount. The [then] Governor of the Panama Canal (a member of the Corps of Engineers) at that time definitely went on record as advocating none but the so-called Sea-Level Project for the major increase of canal facilities, which action served to exclude what may be the best solution when evaluated from all angles.

FIG. 1. Present lock canal is unshaded, and proposed sea-level canal is shaded, on profile of Panama Canal.



This Report, under Public Law 280, 79th Congress, was transmitted to the Congress by the President December 1, 1947, and significantly, without comment or recommendation. The Congress took no action, and the report was not published.

The Terminal Lake–Third Locks Project has been strongly urged as the proper form of modernization by experienced civilian engineers who took part in the construction of the present canal. They have spoken from personal knowledge of the original construction. Their views are shared by many independent engineers and navigators who have studied the subject. All these insist that the present lake-lock type should be preserved as supplying the best canal for the transit of vessels which it is economically feasible to construct. They, together with many of the leading atomic warfare authorities, stress the points that the defense of the canal is an all-inclusive federal responsibility which must be met by active military and naval measures and by industrial planning in the United States; that passive protective features embodied in construction design are inadequate; and that the proper bases for planning canal improvements are capacity and navigational efficiency. Moreover it must be borne in mind that the effective destructive power of the atomic bomb has been tremendously increased since the formal recommendation for a sea-level canal. Any canal, whatsoever the type, can be destroyed by atomic bombing, if permitted to strike.

The recent authorization to expend funds for repairs and alterations of present lock structures at an estimated cost of $26,500,000 is, as we believe, makeshift in character, and is without real merit. Consummation thereof, in lieu of fundamental improvements, will inevitably delay the basic and long-overdue solution of the problems involved.

In addition to the Panama projects, there are urgent proposals for canals at other locations, some of which have strong support, particularly Nicaragua. In developing a long-range Isthmian Canal policy to meet future interoceanic transit needs, these should certainly receive full and unbiased consideration.

Transcending personal considerations, but nevertheless to state the matter candidly, we submit that the Third Locks Project, as originally planned in 1939 by the [then] Governor of the Panama Canal, has proven most disappointing. We have every reason to believe that the insistently advocated Sea-Level Project (which, as a matter of fact, would require tidal locks as well as vulnerable flood-control reservoirs and dikes) would prove to be a monumental boondoggle, costing the American taxpayer billions of dollars. Both of these efforts were directed by routine administrative agencies, and at heavy public expense.

We wish to stress the fact that, aside from the A-bomb, the recurrent discussions as to the relative advantages and disadvantages of the lake-lock and "sea-level" types of canal were exhaustively investigated, debated, and considered in 1905–1906 when the Congress and the President decided in favor of the lake-lock plan—under which the canal was constructed, and (with the exception of certain operational defects in the Pacific sector) has been successfully operated. The operational defects, we believe, can be adequately corrected.

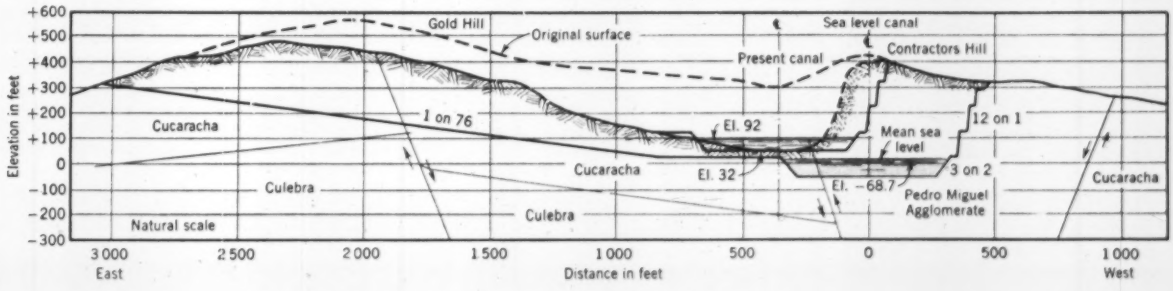
It must be always borne in mind that the greater the cost of increased facilities at Panama the heavier will be the load on the already overwhelmingly burdened American taxpayer; and that also such cost must be reflected in ship-transit tolls, with all that increased tolls imply.

We respectfully urge the early enactment of H.R. 1048, 83rd Congress, introduced by Representative Thomas E. Martin of Iowa, and supported by Representative Clark W. Thompson of Texas, who introduced a like measure in the 82nd Congress. Both of these experienced and highly competent legislators have been thorough students of interoceanic canal problems, which have grave diplomatic implications affecting all maritime nations and the relations of the United States with all Latin-American countries—especially Panama. As to Panama, we would most strongly emphasize that among the features overlooked in the report under Public Law 280, 79th Congress, is the fact that the Sea-Level Project recommended in that report is not covered by existing canal treaties and would necessitate the negotiation of a new treaty with a tremendous indemnity and greatly increased annuity payments involved. As evidence of this it may be noted that upon demand of the Panamanian government, and the appointment by it of a commission for the purpose, the U.S. Government has named a like commission to negotiate various questions, including that of the present annuity of $430,000 (originally $250,000), which Panama insists should be substantially increased. These negotiations began in September 1953, when the President of Panama and members of the Panamanian Commission visited Washington in behalf of the indicated demands.

Conclusion

Because of these considerations, it would seem to be clear that the indicated Commission should be created without delay, and put to work, so as to develop a timely, definite, and wisely reasoned Isthmian Canal policy. Such a body should be made up of unbiased, broad-gaged, and independent men of the widest engineering, operational, governmental, and business experience, and not of persons from routine agencies, all too often involved in justifying their own groups.

FIG. 2. Cross section at Contractors Hill (Mile 33) shows channels of present Panama Canal and proposed sea-level canal. Contract for removal of 3 million cu yd or more of agglomerate rock from top of Contractors Hill, which is threatening to slide into canal, was awarded to Tecon Corporation, Dallas, Tex., in May 1954, by Panama Canal Company.



ENGINEERS' NOTEBOOK

Continuity—asset or liability?

ANTHONY HOADLEY, M. ASCE

Professor of Civil Engineering, Union College, Schenectady, N.Y.

Continuous beams and frames are usually more economical of material than simple beam-and-column construction. This economy of material very often more than pays for the increased cost of the joints required for continuous construction and results in a substantial saving.

The following study of a one-story rectangular rigid frame indicates that a simple beam-and-column design will call for less material than is needed for the rigid-frame construction. The moment thrown into the columns in the rigid-frame construction increases the column weight much more rapidly than the saving in the weight of the beam made possible by the restraining moment at the end. The frame studied was 15 ft high by 38 ft wide. The only load considered was a uniform load of 1,140 lb per ft, which included the weight of the beam. The top flange of the beam was considered to be fully braced by the roof purlins. The columns were hinged at the base.

An analysis of this rigid frame showed that the moment at the top of the column was 39,300 ft-lb and the direct stress in the column 21,700 lb. The moment at the center of the beam was 166,200 ft-lb. Designing the beam and column following the AISC specification resulted in 18 WF 60 for the beam and an 8 WF 35 for the column. The next lighter beam, an 18 WF 55, would have been overstressed by 1.5 percent.

Redesigning the frame with the beam placed directly on top of the column, so that the latter carries a concentric load of 21,700 lb, while the beam carries a moment of 205,500 ft-lb, results in a 21 WF 62 beam and a 6 WF 15.5 column. While this column has a capacity of 43,000 lb, it is the lightest WF section available for the load of 21,700 lb. The beam weighs very little more than that called for in the rigid-frame design while the column weighs only half as much as the rigid-frame column.

A third design was then worked out in which the beam is connected to the flange of the column by a standard A-series connection. This has the advantage of being a more stable construction than that involved in the second design. It is very often assumed that connections of this type carry no moment. In this case, where the exterior column is light, it will be shown that the moment carried by the connection is large in comparison with the moment capacity of the column, although it is quite small as compared to the moment capacity of the beam. In spite of any assumptions made, the connection will carry as much moment as possible, at first by elastic action and then by plastic yielding. Tests made on riveted connections by J. Charles Rathbun, M. ASCE, and reported in the TRANSACTIONS of the ASCE for 1936, show the relation between the moment carried by a riveted joint connecting a beam to a column, and the change in angle between the beam and column due to the yielding of the connection.

A solution for the frame with yielding joints, following the method of analysis devised by Professor Rathbun, gave a moment of 18,500 ft-lb at the connection of beam to column. The experimentally determined relation between yield angle and moment is used in the analytical solution. In Professor Rathbun's report he gives this relation for a connection made of 4 × 3½ × ⅜ × 15-in. angles connected to an 18 I 54.7 with 5 rivets. He also gives another curve for a connection made of 4 × 3½ × ⅜ × 9-in. angles connected to a 12 I 31.8 with 3 rivets. Based on these curves, the estimated angular yield for a standard connection made of 4 × 3½ × ⅜ × 11-½ angles, connected to a wide-flanged beam with 4 rivets, was estimated at 0.008 radians under a moment of 18,500 ft-lb. Professor Rathbun's tests show that this connection would be expected to fail at a moment of 57,000 ft-lb. This design results in a 21 WF 62 beam and a 6 WF 25 column.

TABLE I. Comparison of designs for 15 x 38-ft frame

TYPE	MEMBER	SECTION	WEIGHT
Rigid frame	Beam	18 WF 60	2,280
	Column	8 WF 35	1,050
			3,330
Simple beam on column	Beam	21 WF 62	2,360
	Column	6 WF 15.5	465
			2,825
Frame with yielding connection	Beam	21 WF 62	2,360
	Column	6 WF 25	750
			3,110

The equivalent eccentricity of the load required to produce the moment developed by the standard connection is 18,500 divided by 21,700, or 10 in. The restraining moment is 9 percent of the maximum allowable bending moment in the beam, and represents 66 percent of the bending moment which can be carried by a 6 WF 25 beam.

The summary in Table I shows that the use of a standard beam-to-column connection, or a beam placed on top of a column, saves 10 to 15 percent of the weight of metal called for in the rigid-frame design. For this particular one-story single-bay frame, the moment developed in the column by the standard riveted connection corresponds to an eccentricity of 1.5 times the depth of the column.

A design in which it is assumed that the standard connection carries no moment and delivers a load of 21,700 lb to the flange of the column (eccentricity equals half the column depth) calls for a 6 WF 15.5 column. Normally a column loaded with an eccentricity of one-half the depth would be heavier than one concentrically loaded. Here this is not the case because of the excess capacity of the lightest available section for the concentric load. The framing for many single-bay one-story buildings has been designed with standard riveted connections, and on the assumption that the connection delivers shear and no moment to the flange of the column. However, the writer feels that a better balanced design will result—and one in which the assumed conditions will more nearly approach the actual conditions—when the eccentricity of the beam-to-column connection is taken at about 1.5 times the depth of the column.

Curves give efficiencies of friction pile groups

IRVING B. RAU, A.M. ASCE

Registered Professional Engineer, New Orleans, La.

Solutions to the Converse-Labarre formula for using a reduced supporting value for a group of friction piles in elastic soils are presented graphically as an aid to the foundation designer. The supporting value of such piles varies according to the spacing.

The use of the following formula, Eq. 1, is suggested in the Standard Specifications for Highway Bridges adopted by the American Association of State Highway Officials and required by the Building Code of the City of New Orleans:

$$\text{Efficiency} = 1 - \phi\left[\frac{(n-1)m + (m-1)n}{90\,mn}\right] \quad . \quad (1)$$

in which

ϕ = tangent d/s, in deg
d = diameter of pile
s = spacing of pile centers
n = number of piles per row
m = number of rows

In the accompanying diagrams, Fig. 1 (*a*) through (*d*), solutions have been plotted for several values of d/s selected as being representative of the magnitude of range commonly encountered in practice. The designer may interpolate or extrapolate slightly if necessary, as the curves are not too sensitive for that, and extreme accuracy in unwarranted.

Supporting value of group

The supporting value of a group of friction piles is less than the sum of the individual piles because of overlapping of the bulbs of pressure. As these bulbs spread out with increasing depth, it follows that the percentage reduction would be increased, but the effect due to pile length is not taken into account in the formula.

The character of the soil is another important factor. It would appear to be more justifiable to use this formula in elastic soils than in non-elastic soils such as sand. Soil character is not evaluated by the formula.

Test loads of a few days' duration on friction piles in elastic soils are not in themselves true tests of the later behavior of the permanent piles under long-continued loading.

The foundation designer must realize that the factors mentioned above are indeterminate. However, he may find the curves here presented of qualitative assistance in conjunction with the quantitative results of the test loads to help his judgment in the final foundation design.

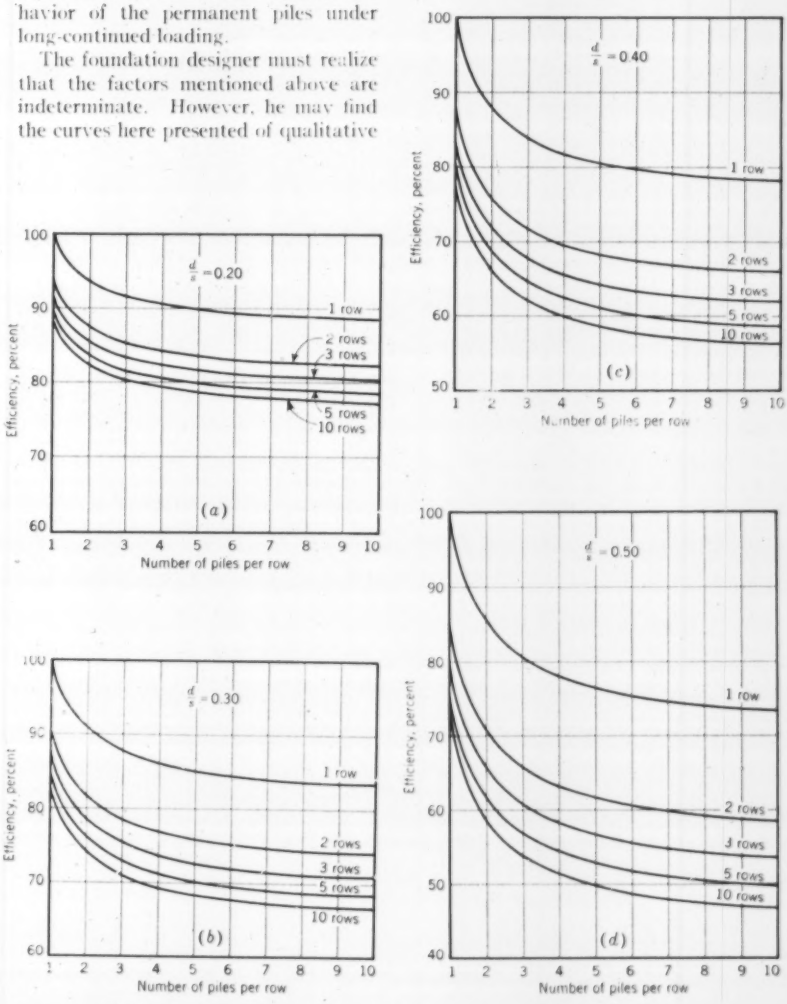


FIG. 1. Efficiency of pile groups is plotted according to various values of d/s (pile diameter to spacing of pile centers) selected as being representative of range commonly encountered in practice. Efficiency of single, isolated pile is taken as 100 percent.

THE READERS WRITE

Compression reinforcing design further simplified

To the Editor: The article by Jack Moyse, "Simplifying Compression Reinforcing Design," in the April 1954 issue, portrayed an excellent approach to this subject. However, the writer believes that a much more direct and workable method is presented in the following solution of the same example Mr. Moyse gave.

For the reader's convenience, pertinent data are repeated as follows:

M = 320 ft-kips	f_s = 20 kips per sq in.
b = 17 in.	n = 10
d = 31 in.	f_c = 1.2 kips per sq in.
d' = 2 in.	k = 0.375
$d - d'$ = 29 in.	j = 0.875
	K = 197

M = 320 ft-kips

$$Kbd^2 = 0.197 \times \frac{17 \times 31^2}{12} = 268$$

$M - Kbd^2 = 52$ ft-kips

$kd = 0.375 \times 31 = 11.6$ in.

$$f''_c = \frac{9.6}{11.6} \times 1.2 = 0.99 \text{ kips per sq in.}$$

$f'_s = (10 \times 0.99)\,2 - 0.99 = 18.8$ kips per sq in. (per ACI 318-51, Sec. 706)

$$A'_s = \frac{52 \times 12}{18.8 \times 29} = 1.14 \text{ sq in.}$$

$$A_s = \frac{320}{1.44 \times 31} = 7.16 \text{ sq in.}$$

Or, if precision is required:

$$A_{s1} = \frac{52 \times 12}{20 \times 29} = 1.07 \text{ sq in.}$$

$$A_{s2} = \frac{268 \times 12}{20 \times 0.875 \times 31} = 5.93 \text{ sq in.}$$

Total A_s = 7.00 sq in.

Note the effect of plasticity allowance in the design of A'_s. Also note the rather specific tie requirements of ACI 318-51, Sec. 706.

Norman B. Jones, J.M.ASCE
Structural Engineer
Whittier, Calif.

Ground vibration formulas corrected

To the Editor: I would like to call your attention to three typographical errors which appear in my article, "Applied Engineering Principles Reduce Costly Accidents," in the June issue, brought to my attention by a reader. I refer to page 53, in the lower half of the center column, the first and third formulas. They should read as follows:

$$KE = \frac{WV^2}{2g}$$

$$ER = \left(\frac{50}{\text{Distance}}\right)^2 C^2K$$

William A. Luna, M. ASCE
Senior Safety Engineer
Liberty Mutual Insurance Co.
New York, N.Y.

Thruway railing stands up under unusual loading

To the Editor: In the paper which I prepared for the ASCE Annual Meeting held in October 1953, I referred, with particular emphasis, to the type of railing used generally on the structures which I design. This paper was published in the November 1953 issue of Civil Engineering.

We developed this particular type of railing after more than a quarter of a century of research. We have designed and built all types of railing, including the so-called heavy reinforced concrete "barrier type."

Under the urging of the federal Public Roads organization, which was making a special effort to keep vehicles on the highway under all circumstances, we established double curbs with these barrier-type railings. We found that there were more accidents—and serious accidents—on the roadway due to the use of double curbs than were prevented by the use of these curbs. Our greatest difficulty was to find a railing which would be pleasing to the eye and strong enough to equal or better the barrier type.

After Civil Engineering published my article, I received numerous communications in regard to it. In almost all cases, the writers indicated that they liked the railing but were hesitant about using it for fear that it would not stand up under the impact of a vehicle out of control.

Immediately after my article appeared, an unusual opportunity was presented for observing the behavior of the railing under extremely abusive treatment. Some boys who were rather large to be playing serious pranks at Hallowe'en, took some equipment being used on a grading contract adjacent to one of the structures on the New York State Thruway and ran wild with it. However, they did not destroy the railing and the equipment did not go over the side of the bridge, down onto the railroad tracks which run under the Thruway structure at this point. It was a rather expensive and harsh way to test the strength of a railing, but it carried conviction when the contractor for the structure indicated that it would be necessary for him to replace only the railing's topmost member. It was not even necessary to realign the railing, and in a few days it was as ready to do its job as it had been when originally installed.

It seems to me that the accompanying photographs are the best answer to those who have written me of their doubts about this railing. These photographs are quite convincing considering the type of equipment shown in them. It was an impressive sight for those associated with the work when they observed the ability of the railing to function under this severe and unusual loading.

E. W. Wendell, M. ASCE
Deputy Chief Engineer, Dept. of Public Works, State of New York
Albany, N.Y.

SOCIETY NEWS

Philadelphia Section Opens Doors of Delaware Valley to June Convention in Atlantic City

Philadelphia members of ASCE played host to well over 500 Society members and their families in Atlantic City at a Convention not soon forgotten by those in attendance. "Delaware Valley—U.S.A.," in the heart of one of the nation's most heavily industrialized areas, was the theme of the Convention. One entire morning session was devoted to discussion of the industrial growth of the valley, its regional planning and highways, water supply, stream pollution control, and a study of the estuary itself.

Atlantic City, long a playground of the Middle Atlantic Coast, welcomed the Convention to the city, presenting President Terrell with its key. (Dean Terrell was concerned with the key's ability to open the jail.)

Highlight of the business meeting was the President's announcement of the passage of the "dues amendment" which needing 67 percent of the votes cast, carried 73 percent affirmative votes—12,035 out of 16,538 votes cast. (Page 67.)

Quick to avail members of the increased funds provided, the Board acted to increase the number of free Proceedings-Separates going to the membership. The plan, to begin in October, is to continue free automatic distribution according to Division interest, plus an, as yet unspecified, number of other Separates available on request.

W. R. Glidden nominated for President

Another important piece of news announced at the meeting was the nomination of William R. Glidden, of Richmond, Va., as President of the Society for 1955. Mr. Glidden, who is assistant chief engineer of the Virginia Department of Highways, has served the Society in many capacities including terms as Director and Vice-President.

President Terrell's annual address

In remarks from his annual address, made during the Wednesday morning meeting, President Terrell stressed the gravity of the engineer shortage and pointed to the ever-new frontiers opening to the profession. "Never before," he said, "have we been so willing and eager to discard the old and seek something new which gives promise of greater comfort and convenience." As a case in point, President Terrell mentioned atomic-energy developments. He also predicted the use of underground conveyors for pedestrians as a solution to the traffic problem in New York and other great cities. The full text of the annual address will be printed in TRANSACTIONS.

Governor's Luncheon

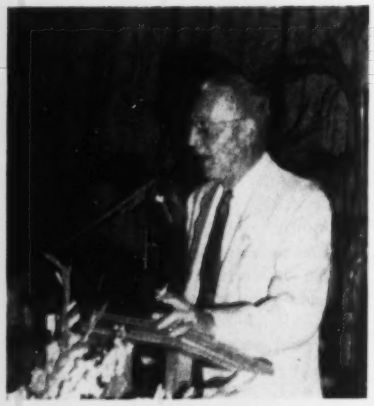
The place of the engineer in our society was particularly well defined by Robert B. Meyner, Governor of New Jersey, in the featured address at the Wednesday luncheon. "If the triumphs of science and technology have changed the dimensions of the world in which we live," said Governor Meyner, "our best thoughts and efforts must be directed toward finding the social, legal, and governmental adjustments that must be made so that we can live in peace and security in this changed world."

He said that the Nobel Prize winning physicist, Dr. I. I. Rabi, at the recent Columbia commencement, "set forth quite forcefully the thesis that 'the solution, if any to the problems of mankind lies in more understanding, deeper insights, greater capacities; in short, more science, not less.'" While science alone cannot save the world, Governor Meyner continued, "engineers already bear a heavy load of community responsibility. The contribution that the engineering profession can make in the years that lie ahead can be significant and will be greatly appreciated."

Emphasizing the "miracles of organization and administration" that lie back of modern engineering accomplishments, the Governor commented "Let no man say that the engineer is unaware of human values and does not appreciate his social responsibilities. . . ."

In conclusion, he said, "And so it is for the qualities of your profession that I salute you today. Whether it be the flow of traffic or the flow of water into a community, it is to the civil engineer that we turn for the 'know-how' and the 'can-do' to bring order and swift, smooth functioning out of confusion and inadequacy. We know that we can rely on the economic justification of the works he proposes. We know that he will marshall the men and materiel', the brains and the bricks, the power and the performance 'for the use and convenience of man.'

ASCE President Daniel V. Terrell (left) congratulates William R. Glidden, of Richmond, Va., new Presidential nominee. A former Director and Vice-President of ASCE, Mr. Glidden was nominated for President in 1955 during Atlantic City Convention.



"Your distinguished professional leadership is part and parcel of the American heritage and part of the American dream."

Convention Dinner

Another distinguished talk was that given by the Hon. Kurt F. Pantzer at the Convention Dinner on Wednesday evening. As special master for the Supreme Court in New York City's long struggle for additional water from the Delaware, Judge Pantzer is given much credit for the widely praised decision in the case recently handed down (item on page 76). He commented that he enjoyed working with engineers—not so much for their technique as for their thinking. The thinking of lawyers is based on the Socratic philosophy of "breaking down" and "tearing apart," he said, whereas the thinking of engineers is founded on the philosophy of Descartes which is a philosophy of synthesis and building up.

The other after-dinner speaker was the Hon. Con McCole, mayor of Wilkes-Barre, Pa., and nationally famous raconteur, whose stories are as entertaining as they are endless. The toastmaster was Joseph R. Farrell, chairman of the Entertainment Committee.

A special feature of the dinner program consisted of the presentation of awards to two of last year's prize winners, who had been unable to attend earlier meetings. Henry M. Paynter, Jr., J.M. ASCE, assistant professor of hydraulic engineering at Massachusetts Institute of Technology, received the Alfred Noble Prize, and Charles W. Griffin, Jr., J.M. ASCE, structural engineer for United Engineers and Constructors, Inc., Philadelphia, the Daniel W. Mead Prize.

Technical program on Delaware Valley

A special two-hour Symposium on the Delaware Valley—U.S.A. featured talks by Walter P. Miller, president of the Chamber of Commerce of Greater Philadelphia; Edmund N. Bacon, executive director, Philadelphia City Planning Commission; Francis S. Friel, Past-Director of ASCE, Philadelphia consultant; H. E. Moses, director of the Bureau of Sanitary Engineering, Pennsylvania Department of Health, Harrisburg; and Clarence F. Wicker, chief of the Engineering Division of the U. S. District Engineer Office, Philadelphia. Underscoring the natural resources of the area, the speakers clearly demonstrated what coordinated engineering effort can do for an entire river basin.

With the Delaware Valley the Convention theme, a number of the Technical Divisions devoted their programs to study of projects and problems of this highly industrialized area. In a paper entitled, "New York's Extension of its Sources to the Delaware," presented at a joint session of the Hydraulics and Sanitary Engineering Divisions, Karl R. Kennison, chief engineer of the New York City Board of Water Supply, made the surprising statement that New York's daily per capita consumption of 136 gal makes it the smallest per capita water consumer of the nation's nine largest cities. Nevertheless, he emphasized, the city's needs grow so fast they are only a step behind increasing supplies.

In top photo Robert B. Meyner, Governor of New Jersey, is seen delivering his brilliant address on "The Place of the Engineer in Our Society" at the Wednesday luncheon. Convention Dinner shots show Toastmaster Joseph Farrell (in white suit), chairman of entertainment for Convention, and a group at the speakers' table, with Raconteur Con McCole at the microphone, speaker Kurt F. Pantzer seated next to him, and Irving V. A. Huie, of the New York Board of Water Supply at the extreme right. The happy trio just served with lobster consists of Prof. Samuel T. Carpenter, Technical Program Chairman; Thomas Buckley, co-chairman of excursions; and ASCE Director Oliver W. Hartwell, general Convention chairman. Lower right view shows what happened when the clambake pit was opened.

Local Section Conference

Some twenty delegates from Sections in the Middle Atlantic area met for a two-day conference during the Convention to discuss the problems of Local Section operation. In shirt-sleeve sessions, the representatives from Sections and Subsections exchanged experiences in candid and stimulating fashion. Subjects on the agenda included building attendance at Local Section meetings through effective programs; organization and operation of Subsections and Branches; cooperation with Student Chapters in the area; coordination of meeting dates and programs with other engineering groups in the area; and public relations programs.

Chairman Frank C. Mirgain noted that the general public today is very engineering-conscious, and that the advice and consultation of engineers in community projects is eagerly sought. The way is open for engineers to assume their role as leaders of their communities, he emphasized.

Making new members and Junior Members feel at home when they attend meetings is one way of assuring their continued participation in Section affairs, the delegates were informed. The point was also made that opportunity to participate actively in Section affairs is necessary to maintain the interest of Junior Members.

Scene from one of the Authors' Breakfasts that served as briefing sessions each day shows Don. P. Reynolds, assistant to the Secretary of ASCE; Howard Critchlow; Professor Carpenter; and Admiral William M. Angas.

Clambake Social Program Highlight

The clambake received a ravenous delegation head-on. "If an oyster had an eye, I couldn't look him in it," said one civil engineer casually tossing his eighteenth half-shell into a barrel. Few conventioneers had the capacity for the clams, oysters, lobsters, steamers, chicken, and other fixin's available to them at the Atlantic City Country Club. Borne by a chill ocean breeze, the aroma of steaming clams and lobster cooking away in mounds of rockweed and salt water roused even the feeblest of appetites to lion-size proportions. The oom-pah of the "German Band" astounded everyone by turning into extremely danceable music at the conclusion of the salty feast.

Convention Committee

The time and efforts of many members of the Philadelphia Section went into making the Convention the success it was. Special kudos are due ASCE Director Oliver W. Hartwell, general chairman; Samuel S. Baxter, vice-chairman; Samuel T. Carpenter, Technical Program Chairman; Joseph Farrell, chairman of entertainment; and Mrs. Samuel S. Baxter, chairman of Ladies Activities.

Actions of Board of Direction at Atlantic City Briefed

The principal business transacted by the ASCE Board of Direction at its meeting in Atlantic City, N.J., June 14 and 15, is summarized here.

Dues Amendment Approved by Membership

By formal action the Board expressed its appreciation to President Daniel V. Terrell "for his diligent efforts, work and travel in the interest of stimulating membership approval of the Constitution amendment, which will increase the annual dues of the Society." The report of the tellers is given elsewhere in this department.

Advertising by Engineers

A progress report by the Committee on Professional Practice on the question of the dividing line between proper and improper advertising for professional engineers was received and referred back to the committee, with an expression of hope that a final report would be available at the Board's next meeting.

Mead Prize Subject Is Advertising

The subject for both Junior Member and Student Chapter contestants for the 1955 Mead Prize was announced as "What kind of advertising should be considered as derogatory to the engineering profession?" Examples may be used in developing the subject.

National Water Policy

With reference to the Upper Colorado River Project, the Board requested the President to write a letter of protest to appropriate committees of Congress supporting the action of EJC [shown elsewhere in this department], protesting against passage of any legislation which would approve the Upper Colorado River Project before Congress has had an opportunity to receive and study the forthcoming report of the Hoover Commission on National Water Policy.

Social Security

Strong objection was expressed to the proposed amendment to the Social Security Act, which would provide for compulsory coverage of self-employed professional engineers, instead of voluntary coverage. These views are to be communicated to appropriate committees of the Senate in connection with current Social Security Act legislation.

Federal Civil Service Salaries

With respect to Federal Civil Service salaries, the Board stated that federal pay scales for engineers should be maintained at levels comparable to those prevailing in private, corporate, and industrial practice.

Competitive Bidding

As noted elsewhere in this issue, the Board will provide an opportunity for engineers involved in recent competitive bidding to be heard at an executive session of the Board. The Board's Committee on Professional Conduct was instructed to continue its current investigation of alleged competitive bidding practices in the Ohio State Highway Department.

Advisory Board St. Lawrence Seaway

Since the work of the Advisory Board of the St. Lawrence Seaway Development Corporation (P.L. 358, 83rd Congress) encompasses engineering works of great magnitude, the Board has requested the President of the United States to give every consideration to the appointment of one or more engineers to that Board. This request is being taken in conformity with a long-established ASCE policy that all federal appointing officers should give serious consideration to the appointment of engineers to all positions for which engineers are especially qualified by training and experience. This action followed

closely the EJC protest to the President of the United States, noting the appointment of two federal officials who are not engineers as the principals on the U.S. Section of the St. Lawrence River Joint Board of Engineers (see item in this issue).

Public Works Planning

A resolution was passed, favoring advance planning for worth-while construction of schools, highways, water and sewerage facilities, and other public works which are badly needed now and in the near future.

EJC Constitution Changes Approved

Approval was voted for major changes to be made in the constitution of Engineers Joint Council, which would permit membership in EJC of associations, affiliates, and individual members.

Encroachment of Government Bureaus

It appears that the Bureau of Reclamation has provided detailed drawings and specifications for a section of the work of the Snowy Mountain Hydroelectric Authority in Australia—part of a $300,000,000 project. The Board instructed its Committee on Professional Practice to investigate the question of whether the large-scale encroachment by government bureaus into the field of private engineering practice is continuing.

District and Zone Boundaries Studied

A report of the Committee on Board Organization Study, which has been examining proposals for a feasible method of revising District and Zone boundaries was received and referred to the Committee on Districts and Zones for recommendations.

Public Works Conference

Approval was given to planning a public works conference at some future date jointly with the American Institute of Architects. The ASCE-AIA Cooperative Committee is studying the feasibility of the proposed conference. Final plans are to be subject to the approval of the Board's Executive Committee.

Three Elected to Honorary Membership

The Board made the following elections to Honorary Membership: Robert J. Cummins, Houston, Tex.; Shortridge Hardesty, New York, N.Y.; and Edward P. Lupfer, Buffalo, N.Y. (Biographies of the new Honorary Members will be published in a later issue.)

Convention Dates Confirmed

The following Convention dates were confirmed: October 18–22, 1954, New York; February 7–11, 1955, San Diego; June 13–17, 1955, St. Louis; and October 24–28, 1955, New York.

Engineering Societies Center Building

The Board noted progress being made toward determining type and location of a new Engineering Societies Center Building. (See item elsewhere in this department.)

Prizes and Awards Announced

Recommendations of the Society's Committee on Prizes were approved. The winners are named in an item elsewhere in this issue.

J. Waldo Smith Hydraulic Fellowship

The Committee on the J. Waldo Smith Hydraulic Fellowship has selected Gunnar Sigurdssen, graduate student at Georgia Institute of Technology, as the J. Waldo Smith Fellow for the 1954–1955 academic year. The award provides a cash stipend of $1,000, plus additional funds not in excess of $400 for the purchase of physical equipment.

Special Commendation to J. K. Finch

On recommendation of the Society's Committee on Prizes, President Terrell was authorized to send a warm letter of commendation and appreciation to Dean J. K'p Finch, M. ASCE, for his outstanding paper, "A Hundred Years of American Civil Engineering," published in the 1953 Centennial Transactions. The special commendation developed because Dean Finch's valuable paper could not be considered under the rules for any of the established Society prizes.

Multiple-Purpose Water Projects

The Committee on Cost Allocation for Multiple-Purpose Water Projects of the disbanded Engineering-Economics Division was reconstituted as an ASCE Task Committee and charged with the responsibility of revising its July 1948 tentative report for publication and distribution by the Society.

Convention Exhibits

Consideration was given to the matter of commercial and other exhibits at ASCE Conventions but action was deferred to the October meeting.

Death of E. Graham Clark

A resolution of sympathy was passed on the death of E. Graham Clark on the eve of his retirement as Secretary of the Institution of Civil Engineers of Great Britain. The resolution has been sent to Mr. Clark's family and to the Institution.

Division Executive Committee Appointees Named

The Board approved the following nominees, made by the Committee on Division Activities, to membership on Division Executive Committees:

Air Transport: Dewey S. Wright (1957) to fill unexpired term of F. L. Meara and Robert Horonjeff

Engineering Mechanics: George W. Housner

Highway: William A. McWilliams

Irrigation and Drainage: H. T. Person

Power: George A. Strandberg

Sanitary Engineering: Richard R. Kennedy

Soil Mechanics and Foundations: Ralph E. Fadum

Surveying and Mapping: Carl M. Berry

Waterways: Rufus W. Putnam

ASCE Prizes and Awards Are Announced by Board

On recommendation of the Society's Committee on Prizes, the Board of Direction at its Atlantic City meeting, approved the following awards and prizes for papers published in Volume 118 and *Volume CT* (1953) of TRANSACTIONS. Presentation will be made at ceremonies held during the Annual Convention in New York in October. Further details, together with brief biographies, will appear in a later issue of CIVIL ENGINEERING.

Norman Medal

R. H. SHERLOCK, M. ASCE, for Paper 2553, "Variation of Wind Velocity and Gusts with Height."

J. James R. Croes Medal

F. K. CHANG, A. M. ASCE, and BRUCE G. JOHNSTON, M. ASCE, for Paper 2549, "Torsion of Plate Girders."

Thomas Fitch Rowland Prize

A. WARREN SIMONDS, M. ASCE, for Paper 2537, "Final Foundation Treatment at Hoover Dam."

James Laurie Prize

T. A. MIDDLEBROOKS, A.M. ASCE (deceased), for Paper 2620, "Earth-Dam Practice in the United States."

Arthur M. Wellington Prize

C. H. CHORPENING, M. ASCE, for Paper 2643, "Waterway Growth in the United States."

Collingwood Prize for Juniors

VAUGHN E. HANSEN, J.M. ASCE, for

Paper 2571, "Unconfined Ground-Water Flow to Multiple Wells."

On recommendation of the Technical Division Prize Committees, the Board approved the following awards:

Rudolph Hering Medal

RALPH S. ARCHIBALD, J.M. ASCE, and HAROLD A. THOMAS JR., for Paper 2518, "Longitudinal Mixing Measured by Radioactive Tracers."

Leon S. Moisseiff Award

J. M. RAPHAEL, A.M. ASCE, for Paper 2547, "The Development of Stresses in Shasta Dam."

James W. Rickey Medal

JULIAN HINDS, M. ASCE, for Paper 2605, "Continuous Development of Dams Since 1850."

J. C. Stevens Award

W. DOUGLAS BAINES, J.M. ASCE, for Paper 2569, "Application to an Hydraulic Problem."

Construction Engineering Prize

MAJ. GEN. SAMUEL D. STURGIS, JR., M. ASCE, for paper in September 1953 issue of CIVIL ENGINEERING, "Arctic Engineering Know-how Gets Acid Test at Thule."

No award is made this year for the Karl Emil Hilgard Prize.

Dues-Increase Ballot Carried by 1,009 Votes

ASCE Board Room at Society Headquarters was a busy place on June 10, as the votes of 16,555 members, registering their opinions on the ballot for amending the Constitution to provide for a change in the dues schedule, were counted.

Ballots on amendment of Article IV, Section 2, of the Constitution, providing for change in the dues schedule, were counted in the ASCE Board Room on June 10. Results were as follows:

Yes	12,035
No	4,503
Blank	11
Void	6
Total	16,555
Total votes counted (Yes and No)	16,538
Required to carry	11,026
Carried by	1,009

Tellers Summary Sheet

Constitutional Amendment for Change in Society Dues Schedule Counted June 10, 1954

DISTRICT	VOTES "YES"	VOTES "NO"	TOTAL	APPROXIMATE NUMBER OF ELIGIBLE VOTERS
Foreign	340	100	440	1,510
APO	199	65	264	909
1 (except foreign)	1,792	133	1,925	3,620
2	546	222	768	1,793
3	430	112	542	1,077
4	479	216	695	1,605
5	372	179	551	1,224
6	710	253	963	2,062
7	610	263	873	1,994
8	566	268	834	1,688
9	675	277	952	2,130
10	791	390	1,181	2,510
11	1,850	790	2,640	5,572
12	738	307	1,045	1,964
14	474	216	690	1,475
15	866	372	1,238	2,679
16	597	340	937	2,117
Total	12,035	4,503	16,538	35,929

Professional Ethics Hearing

Members of ASCE who participated October 27, 1953, in bidding procedures covering procurement of consulting engineering services by the Highway Department of South Carolina will have an opportunity to be heard at an Executive Session of the ASCE Board of Direction as to why such bidding by engineers does not violate the Society's Code of Ethics. The ASCE Code states that:

"It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers. . . . to participate in competitive bidding on a price basis to secure a professional engagement."

Following a preliminary investigation ordered last February by the Board, the ASCE Committee on Professional Conduct, at the June meeting just concluded, recommended that all the ASCE members apparently involved be given a hearing by the Board of Direction. The Board approved the recommendation.

The Constitution and Bylaws of the Society provide that any member alleged to have violated the ASCE Code of Ethics shall be given an opportunity to defend himself before the Board of Direction, either in person or in writing, against such allegation. Power to impose disciplinary penalty, including power of expulsion from Society membership, rests solely with the Board of Direction.

EJC Urges Reconsideration of Upper Colorado Project

The House Rules Committee is considering legislation proposing adoption of the billion-dollar Upper Colorado Project. Engineers Joint Council, at a recent meeting, expressed deep concern because many of the "Principles of a Sound National Water Policy," enunciated in its published report of July 1951, are violated by the terms of the bill reported out of the Interior Subcommittee.

The major changes in national water policy contemplated by the bill, EJC believes, would be seriously opposed to the best public interest. It pointed out to Congressman Leo E. Allen, Chairman of the House Rules Committee, the desirability of deferring consideration of this bill upon the floor of the House until the Hoover Commission report to Congress is available. One of the sections of the Commission's report is being prepared by its Task Force on Water and Power.

An Engineering Board Without Engineers

Engineers Joint Council reports with regret the creation of a St. Lawrence River Joint Board of Engineers composed of four men, of whom only one is an engineer. The Joint Board is made up of a United States Section and a Canadian Section. It is the Canadian Section which has the engineer. The United States Section, comprising two non-engineers, political figures, was named by President Eisenhower in an Executive Order dated November 4, 1953. Among the duties of the Joint Engineer Board, as stated in the Executive Order, are:

"To review and coordinate and, if both governments so authorize, approve the plans and specifications of the works and the programs of construction thereof submitted for the approval of the respective governments as specified above, and to assure the construction of the works in accordance therewith as approved."

Correspondence between EJC (represented by Carlton S. Proctor, chairman of its National Engineers Committee) and the White House (represented by Sherman Adams, Assistant to the President), beginning in December 1953, has not been persuasive in getting engineers named to the United States Section.

In EJC's view, "It seems apparent from the name of the Board and the description of its duties that the engineers are clearly required and are specified to constitute the membership of the Joint Board and its United States Section. Indeed the duties prescribed are such that only engineers of ripe experience and judgment could accomplish them successfully."

Mr. Adams' reply noted that alternates for both principal members of the United States Section had been designated, and that both alternates are qualified engineers.

In emphasizing its stand, E.J.C. responded that the engineering profession had counted on this administration to appoint professional men such as engineers, lawyers and doctors to positions requiring their specialized knowledge. "Is it possible," EJC asked, "that the President could not find, in government service or out, among the 500,000 engineers of the nation, as many as two engineers he deemed capable of being appointed as principals to positions which so clearly require members of the engineering profession?"

In conformity with long-standing policy of Engineers Joint Council and ASCE to advocate appointment of engineers to positions for which they are especially well qualified by training and experience, the ASCE Board of Direction, on June 15, 1954, passed the following resolution:

"Since the work of the Advisory Board of the St. Lawrence Seaway Development Corporation encompasses engineering works of great magnitude, the Board of Direction shall go on record through proper channels to request the President of the United States and other federal administrative authorities to give every consideration to the appointment of one or more engineers on the Advisory Board of the St. Lawrence Seaway Development Corporation."

Duties of this Advisory Board will include review of policies in connection with the design and construction of the St. Lawrence River development.

Philadelphia Wants Engineering Societies Center

Philadelphia has entered its claim for consideration as the best location for the proposed new Society headquarters. The Philadelphia Committee on an Engineering Center Building has submitted a comprehensive brochure setting forth its reasons to the Committee of Five Presidents (June issue, page 75). The site proposed is all or part of a $6\frac{1}{2}$-acre city block just west of the Schuylkill River, bounded by 32nd and 33rd and Chestnut and Walnut streets. It is adjacent to the campuses of the University of Pennsylvania and Drexel Institute. Franklin Field, Convention Hall, the Post Office, and the 30th Street Station of the Pennsylvania Railroad are nearby. The brochure proposes combining the Engineering Societies library with the libraries of Drexel Institute and the University of Pennsylvania, and suggests a headquarters building for the Engineers Club of Philadelphia on the same site.

The present Engineering Societies Building in New York is owned and operated by United Engineering Trustees for the owners, the four Founder Societies. General supervision of operation and maintenance of the building, and the purchase, lease or sale of real estate for use of the corporation are placed, by UET bylaws, in the hands of its Real Estate Committee.

Currently the pressing problem of the Real Estate Committee is to advise the trustees on adequate quarters for the organizations occupying the present building or the organizations that would probably occupy a new building constructed by UET for similar purposes. The problem of a new building has been under consideration for a number of years, and a solution is needed soon. In an effort to resolve the question, W. N. Carey, new chairman of the Real Estate Committee and the Society's trustee on UET, has selected a task committee of Society representatives to gather data needed by the Real Estate Committee, by the Committee of Five Presidents, and by UET before making initial decisions.

The Task Committee consists of W. N. Carey, chairman; Nelson S. Hibshman, AIEE; Peter J. Apol, AIME; Walter Letroadec, ASME; F. J. Van Antwerpen, AIChE; and John A. Zecca, ASCE. James F. Head is chairman and J. H. R. Arms, secretary of UET. The Real Estate Committee, in addition to Chairman Carey, includes: Willis F. Thompson, of ASME; E. C. Meagher, of AIME; and A. G. Oehler, of AIEE.

Cities currently under consideration for the location of the Engineering Societies Center Building are New York, Philadelphia, Washington, D.C., Pittsburgh, and Chicago.

Ground Water Committee Plans Hydrology Manual

Plans for the preparation of a manual on underground hydrology are being made by the Irrigation and Drainage Division's Committee on Utilization and Development of Ground Water Storage for Irrigation. The new manual will be a companion volume to the Hydrology Handbook (Manual No. 28) issued in 1949. It will contain a thorough exposition of the use, development, and utilization of ground water storage capacity with particular reference to the planned operation of ground water reservoirs in coordinated development of available water supplies.

A symposium on the use and development of ground water in each of the Western states where such developments are a major factor in meeting agricultural and municipal requirements is also planned by the committee.

Harvey O. Banks is chairman of the committee, and R. O. Thomas secretary. Other members include T. R. Simpson, C. H. Milligan, F. Hotes, and Dean C. Muckel.

Bibliography on Filing For Engineering Offices

Availability of a selected list of references prepared for engineers and librarians concerned with organizing their files is announced by the Engineering Societies Library. The references cover articles on filing from magazines, books, and pamphlets, classification and indexing, lists of subject headings, and hand-sorted punched-card systems suitable for organizing small collections of engineering books, notes, correspondence, abstracts, reprints, drawings, maps, catalogs, etc.

Issued as ESL Bibliography No. 9, the 18-page mimeographed publication is available from the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y. The price is $2.00.

More Benefits Offered in ASCE Group Disability Plan

A new benefit for members enrolled in the ASCE Group Disability Plan, approved several years ago by the Board of Direction, is announced by Smith & Sternau, Inc., administrators of the plan. Heretofore the weekly benefits for loss of time resulting from accidents were paid for a maximum of five years. Starting August 1, 1954, the fifth anniversary of the plan, the company will extend the coverage from five years to lifetime protection at no extra cost.

This additional benefit has been made possible because of the satisfactory claim experience of the ASCE group. It will be added to all policies now in force, and will also be included in new contracts issued after August 1, 1954.

Upon request Smith & Sternau (595 Madison Avenue, New York 22, N.Y.) will help compare the Society's approved group plan with other individual group plans.

ASCE MEMBERSHIP AS OF JUNE 9, 1954

Members	8,608
Associate Members	11,100
Junior Members	17,658
Affiliates	70
Honorary Members	42
Total	37,478
(June 9, 1953	36,270)

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

The unlimited opportunities in the civil engineering field were stressed in the leading talk at the **Akron Section's** April meeting by Stanley Macomber, president of Macomber, Inc., of Canton, where the meeting was held. Mr. Macomber's talk, which was directed toward young engineers, contained much good advice and encouragement. Rigid-frame versus stringer-type bridges and prestressed concrete bridge girders were discussed at the May meeting. The speakers were Luke Sveda and Joe Wilson, students at the University of Akron.

Kenneth D. Hoyt has been appointed associate editor of the **Alaska Section's** Newsletter. The Newsletter now includes a round-up of construction activity in the Territory.

In a talk entitled "Operation Red Gold," given at the **Buffalo Section's** April meeting, Robert P. Gibson, field engineer for the Republic Steel Corp., described the vast new iron ore deposit straddling the Laborador-Quebec border. Development of this rich field, which may rival the Mesabi range in Minnesota, required the building of a 360-mile railroad and epoch-making industrial construction, which were also discussed by Mr. Gibson.

ASCE President Daniel V. Terrell commented on professional ethics, especially in the matter of advertising for competitive engineering services, in the leading talk at the Central **Illinois Section's** Apri meeting.

Members of the **Central Ohio Section** were guests of the Ohio University Student Chapter at a meeting in Athens,

Larry Bivens (left) receives Arizona Section's annual student award for the outstanding civil engineering senior at the University of Arizona. The reward was made at the Section's spring meeting in Tucson on May 8 where Mr. Bivens also presented the best student paper.

Edward M. Fucik (standing), president of the Illinois Section, is master of ceremonies at the Section's sixth annual meeting at the University of Illinois, Chicago Undergraduate Division. Pictured (left to right) are Jerry Scandella, president of the Illinois Institute of Technology Chapter; Benjamin Wasil, faculty sponsor of the Illinois Tech Chapter; Walter Hamilton, sponsor of the Northwestern University Chapter; J. C. Chaderton, sponsor of the University of Illinois, Navy Pier Division; Mr. Fucik; Virgil E. Gunlock, Chicago Commissioner of Public Works and featured speaker; W. W. De Berard, Honorary Member of the Society and chief city water engineer of Chicago; and F. W. Trezise, associate dean of the engineering college at Navy Pier.

Ohio, on April 29. E. H. Karrer, professor of civil engineering, was the speaker of the evening, with a talk on the Pan-American Highway. Movies of actual construction in Mexico and Central America supplemented his talk.

The Fenn College Student Chapter arranged the program for the May meeting of the **Cleveland Section.** Two civil engineering seniors—Daniel Hahn and Les Buchanan—discussed jobs on which they have been employed as part of the college's cooperative educational training program. G. Brooks Earnest, president of the college and Vice-President of ASCE, reported on a recent EJC meeting, at which adoption of a new constitution was discussed.

Top civil engineers in the senior class at Yale University—Richard J. Sylvester and Carlo A. Punceles—received the **Connecticut Section's** annual student awards at its May 12 dinner meeting in New Haven. Harold P. Burrell, chief engineer for the Western Foundation Corp., New York City, was guest speaker, with a talk on the "Franki System of Foundations." At its April meeting, they honored the outstanding students at the University of Connecticut—Russel E. Machol and Philip B. Swain, Jr.

The **District of Columbia Section** has awarded student prizes to the following graduating seniors in the schools in its area: Calvin R. Burke, George Washington University; Terence L. Garmon, Howard University; and Jorge N. Villacres, Catholic University. Presentation of the awards was made at various meetings held at the close of the school year.

There was a good turnout for a recent joint meeting of the **Georgia Section** and the Georgia Institute of Technology Student Chapter, with Tech students supplying the program. At the May meeting of the **Central Savannah River Valley Subsection,** C. D. Williams, chief structural engineer for Patchen and Zimmerman, Augusta consultants, discussed the most commonly used methods of producing prestressed concrete today and outlined advantages and limitations of the various techniques.

At its annual student luncheon on May 21, the **Illinois Section** awarded prizes of Junior Membership in ASCE to outstanding students at the schools in the area. Winners are Harold R. Coldwater and Leonard E. Olson, of the University of Illinois; Harold F. Leiendecker and Edward H. Liebold, of Northwestern University; and Thomas J. Byrne and Harvey P. Pittelko, of Illinois Institute of Technology.

Scheduled ASCE Conventions

NEW YORK CONVENTION
New York, N.Y.
Hotel Statler
October 18–22
1954

SAN DIEGO CONVENTION
San Diego, Calif.
Hotel U. S. Grant
February 6–11, 1955

ST. LOUIS CONVENTION
St. Louis, Mo.
Jefferson Hotel
June 13–17, 1955

The **Intermountain Section** arranged a special meeting on May 28 to give members and University of Utah students an opportunity to hear President Terrell speak. Considerable discussion followed Dean Terrell's talk on current Society activities and plans.

New **Ithaca Section** officers, elected at the annual meeting on May 11, are: Bruno Chape, of Binghamton, president; Marvin Bogema, of Ithaca, and A. F. Underhill, of Elmira, vice-presidents; and William L. Hewitt, of Ithaca, secretary-treasurer. The featured speaker was George E. Symons, sanitary engineer and consulting technical editor of *Water and Sewage Works*, New York, whose subject was the past, present, and future of sanitary engineering. Other doings included the award of a prize of Junior Membership to Cornell student Ivan V. LaFave.

In the **Kansas Section** area two students—Jack Shears, of the University of Kansas, and Arland V. Hicks, of Kansas State College—have received this year's student awards. Presentation was made at a meeting at Manhattan, Kans., on May 5, at which Prof. Linwood Hodgdon, of the department of economics and sociology at Kansas State, was principal speaker.

A student paper competition for Student Chapter members at the University of Kentucky and the University of Louisville was featured at the **Kentucky Section's** April meeting at Lexington. First prize of $15 went to C. Morgan for a paper on "Electronic Chaining"; second prize of $10 to P. H. Brown, for a paper entitled "A Look Through the Rose-Colored Glass"; and third prize of $5 to R. T. Trautwein for a paper on "Expanded Shale Concrete." Honor students winning the Section prizes of Junior Membership, awarded during the meeting, are Martin F. Heil, of the University of Louisville, and J. A. Dutton, of the University of Kentucky. French engineers visiting this country, under the auspices of the State Department, for exchange of technical information were guests of the Section.

The challenges and opportunities of municipal engineering were ably argued at the **Lehigh Valley Section's** April meeting by Samuel S. Baxter, water commissioner of Philadelphia. Mr. Baxter's talk ranged from the growth of the Philadelphia water supply system (which was started in 1799 and has grown until it involves some 2,400 miles of pipe varying in size from 4 to 93 in.) to present experiments with fluoridation of drinking water. Other program features included presentation of a life membership certificate to former city engineer, Robert Lee Fox, and award of a Junior Membership prize to two Lehigh University students for a joint paper on bolted connections.

These University of Kentucky and University of Louisville engineering students are awarded top honors at the annual Engineers' Banquet sponsored by the Kentucky Section. They are (left to right) Jack A. Dutton, honored as U.K.'s outstanding senior in civil engineering; Martin F. Heil, Jr., U. L. outstanding senior; Floyd F. Schrader, Louisville engineer, who made the presentations; Coburn Morgan, U.K. winner of the speaking contest; Paul H. Brown, U.K. senior and runner-up in the contest; and Robert T. Trautwein, U.L. senior, third-place winner. Mr. Morgan's subject was "Electronic Chaining."

A fish and chicken dinner at Cross Lake took 26 members of the **Shreveport Subsection** of the **Louisiana Section** on Cross Lake, La., on May 3. A documentary film on steel bridge construction was shown after dinner.

Charles B. Breed, professor emeritus of civil engineering at Massachusetts Institute of Technology, was guest speaker at the May meeting of the **Maine Section's** Bangor Area group. Speaking on "The Engineer in the Courtroom," Professor Breed discussed the problems facing an expert witness. "Long-Range Urban Planning" was the theme of the Section's annual spring conference, held at the University of Maine on May 5. Taking part in the symposium were S. S. Anthony, superintendent of the Augusta Water District; Roger Creighton and Warkentin Schroeter, Portland and Bangor city planners; and S. J. Ryckman, associate professor of civil engineering at the University of Maine. The evening speaker—Roland B. Greeley, associate professor of regional planning at Massachusetts Institute of Technology—tied together the afternoon discussions and reviewed planning on a state-wide basis.

New officers for the **Junior Branch** of the **Metropolitan Section** are Eugene Jones, president; Martin Kapp and Joseph Ward, Jr., vice-presidents; Harry P. Rode, Jr., secretary; and Louis Cappozoli, Jr., treasurer.

A panel discussion on South Florida sanitary improvements was the principal feature of the **Miami Section's** May meeting. The speakers were the sanitary engineers for three health departments—Robert Quick, Dade County; Norman Tuckett, Broward County; and Robert W. Eddy, Palm Beach County. New officers of the **Palm Beach Subsection** are George Votaw, president; Theodore Jensen, vice-president; and David Brady, secretary-treasurer.

An insight into the contracting business was given **Michigan Section** members attending the May meeting by John W. Armstrong. There were 65 present.

The **Memphis Branch** of the **Mid-South Section** was host to the Section's annual spring meeting in Memphis late in April. The attendance of about 82 included ASCE Director W. E. Carlton, of Rolla, Mo. The two-day program included a paper on design and construction of the thin-shell hangar being built at the Millington, Tenn., Naval Air Station, which was also the objective of a field trip. The authors were Comdr. John Kolezar, public works officer and C. L. Sloan, of R. P. Farnsworth & Co. Other speakers were J. E. Durstine, district sales manager for the Lincoln Electric Co. at Birmingham, Ala., whose subject was "Stress Analysis Using Photoelasticity Methods"; Paul Farrell, director of the Division of Sanitary Engineering, Tennessee State Department of Public Health, who discussed the role of the state in prevention of stream pollution; and T. D. Bell, industrial engineer for the E. I. du Pont de Nemours Co., whose topic was the job training of young engineers. During the evening banquet certificates of life membership were presented to Frank Ragsdale and B. S. Merrill. Frank T. Quinn was meeting chairman.

The present New York City water shortage and plans made by the city to obtain new upland sources of supply were discussed at the May meeting of the **Mohawk-Hudson Section** by Arthur C. Ford, New York City Commissioner of Gas, Electricity and Water. There were 60 present at the meeting, which was held in Kingston, N.Y. In cooperation with the New York State Thruway Authority, the Section recently arranged a tour of completed parts of the Thruway for Union and Rensselaer Polytechnic Insti-

Featured speaker at joint meeting of Northeastern Section and Boston Society of Civil Engineers is John M. Kyle (second from left), chief engineer of the Port of New York Authority. Reading left to right are Prof. John B. Wilbur, president of the Northeastern Section; Mr. Kyle; Miles N. Clair, president of the Boston Society of Civil Engineers; and Herman G. Protze, Transportation Section, BSCE. Mr. Kyles's subject was "Traffic Unlimited."

The Executive Committee of the Tennessee Valley Section is photographed with ASCE Director James A. Higgs (seated, left) and Walter E. Jessup, editor of "Civil Engineering" (seated, right) at the Section's spring meeting at Muscle Shoals, Ala. Section President John C. Voorhees is between the two guests. Shown standing, in usual order, are E. M. Titus, secretary-treasurer of the T.V. Section; Nathan E. Way, president of the Knoxville Subsection; A. B. Goodwin, vice-president of the T.V. Section; Joseph P. Bouquard, president of the Chattanooga Subsection; and James D. Flagg, president of the Muscle Shoals Subsection. (Details of the Section's spring meeting elsewhere in this department.)

tute students. The tour ended at the Hudson River Bridge at Nyack, where Emil H. Praeger, designer of the project, showed the group about the bridge site.

To the growing list of Section publications, the **Nashville Section** adds Vol. I, No. 1 of an interesting mimeographed monthly. Members of the Section are being urged to submit a name for the newsheet, which to date is nameless. A prize of $10 is offered for the best name.

Shortage of money and shortage of trained personnel are the two major problems confronting the Nebraska State Highway Department, L. N. Ress said in the leading talk on "Nebraska's Highway Problems" at the **Nebraska Section's** May meeting. The program was a feature of the 23rd annual Spring Roundup of the Nebraska Engineering Society.

Award of Junior Memberships in the Society was one of the highlights of the **North Carolina's Section's** spring meeting held at Duke University, Durham, on May 7. The winners from Duke were S. K. Blackley and James L. Cranwell, and from North Carolina State College, B. E. Rigerstaff, W. C. Raybon, Jr., and William P. Taylor. Other honors, in the form of checks and certificates of appreciation, were given by the AGC Building Division to the two top students in the construction courses at North Carolina State—James G. Barlow and Thomas F. Smith. Students were also responsible for the interesting and diverse technical program.

Members of the Junior Branch of the **Pittsburgh Section** recently inspected first sections of the Ohio Turnpike. The tour was escorted by Charles R. Way, member of the Section and resident engineer on the project for the George S. Richardson Co.

The program for the **Seattle Section's** May meeting was supplied by University of Washington students, who presented three papers in a competition for prizes. The winning paper by Jerry Smith, was a justification of prestressed concrete. Tom Gibbs, president of the Student Chapter was master of ceremonies.

Engineering Wonders of the Tennessee Valley, selected by the executive committee of the **Tennessee Valley Section** and announced at the spring meeting at Muscle Shoals, Ala., are: (1) Engineering works of the TVA; (2) the Oak Ridge development; (3) the Arnold Engineering Development Center; (4) the Tennessee Eastman Development at Kingsport, Tenn.; (5) engineering works of the Aluminum Company of America in the Alcoa, Tenn., vicinity; (6) the Classification Yards of the Southern Railway System in the Tennessee Valley; and (7) the highway system of the Great Smoky Mountains National Park. ASCE Director James Higgs and Walter E. Jessup, editor of CIVIL ENGINEERING, were guests of honor speakers. Mr. Higgs urged intensified support of the Society's Student Chapters, and Mr. Jessup discussed CIVIL ENGINEERING as a medium for the presentation of Society news. The technical program, under the chairmanship of Vice-President Albert Goodwin, featured five brief talks on local projects by engineers of the Muscle Shoals area: J. H. Mayer, chief engineer of the Alabama Asphaltic Limestone Co.; Frank G. Crow, manager of the Florence, Ala., Department of Utilities; Paul E. Brandt, chief designer engineer of the Reynolds Metal Co.; and M. M. Striplin and Edward H. Hauer, of the local TVA office. A Saturday tour of TVA facilities at Muscle Shoals and Wilson Dam concluded the program.

Randle Alexander, bridge engineer for the Texas State Highway Department, Austin, is president of the **Texas Section**—not John H. Montgomery as was mistakenly reported in the item on the forthcoming Hydraulics Division meeting in the May issue.

Members of the **West Virginia Section** heard an account of the construction of the West Virginia Turnpike at a meeting in Charleston on June 4, and next day made an inspection tour of the project. C. H. Peterson, project engineer for Howard, Needles, Tammen and Bergendoff on the work, was the speaker. The attendance of 60 included ASCE Director George W. McAlpin.

An informative talk on "The Effects of Population Concentration on Weather" was given at the **Wisconsin Section's** May meeting at Madison. The speaker was Reid Bryson, chairman of the Department of Meteorology at the University of Wisconsin.

Coming Events

District 6 Council—Meeting at the Ingleside Hotel, Staunton, Va., July 30 and 31.

Illinois—Weekly luncheon meetings featuring 10-minute speeches at the Chicago Engineers' Club, 314 South Federal St., every Friday, 12 noon.

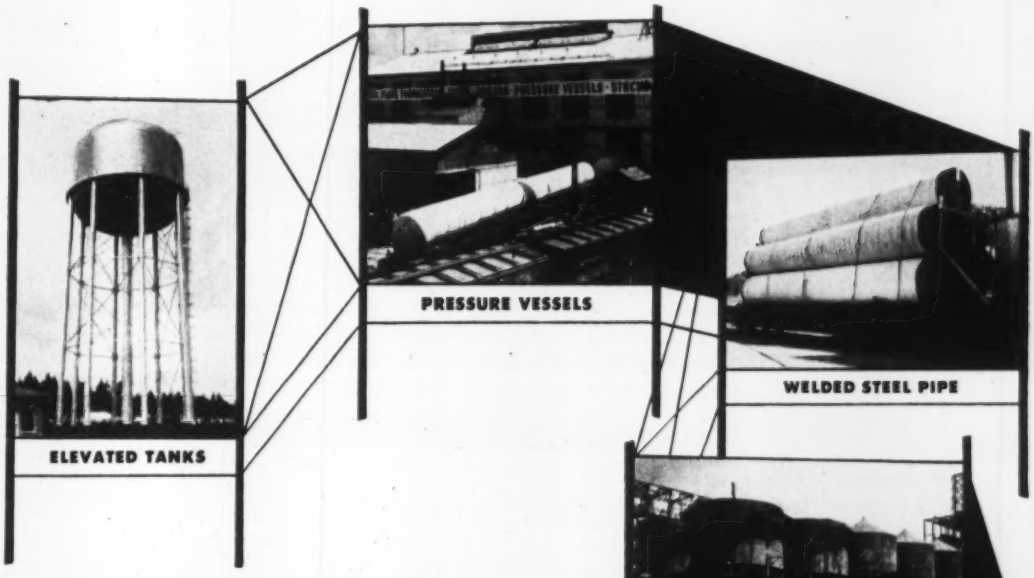
Georgia—Summer outing at the American Legion Home, Avondale, Ga., July 31, starting 2:30 p.m. Program for the day includes golf, swimming, dancing, and dinner at 7 p.m. ($2.75 per person).

Maine—Anniversary Banquet at the Worster Hotel, Hallowell, Me., at 6:30 p.m., with ASCE President D. V. Terrell, the guest speaker.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon.

Governor Shivers Invites ASCE to Austin Hydraulics Meeting

The Hon. Allan Shivers (right), governor of Texas, meets with Austin engineers to issue a special invitation to all ASCE members to come to Austin for the meeting of the Hydraulics Division, September 8–10. The program, headed by Robert L. Lowry, will include an Ice Breaker Party; an evening trip up the Colorado River by paddle-wheel boat to Green Acres for a Texas-style barbecue; and a post-meeting inspection trip to the chain of six reservoirs and hydro plants upstream from Austin. The five technical sessions will feature 22 papers. Shown here (in usual order) are Walter Moore, president of the Austin Branch; John H. Montgomery, vice-chairman of the Convention Committee; Randle Alexander, president of the Texas Section; and Governor Shivers.



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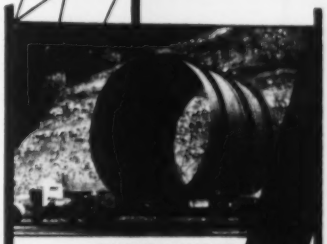

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FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Several statements on pending legislation have been submitted to congressional committees by ASCE and Engineers Joint Council during the past month.

Federal Civil Service Salaries

In our continuing concern over the problems affecting civil engineers in private practice, it is important that we do not neglect problems facing our many members employed by the federal government. Although salary increases have been granted to federal employees to meet increased living costs, these increases have not been great percentagewise in the higher grades of the Civil Service. The incentive to rise to a position of responsibility has thereby been lessened.

Following the adoption of a general resolution on the subject by the Executive Committee of the Society, the Field Representative presented a statement for the record to the Committee on Post Office and Civil Service of the House of Representatives in connection with the current hearings on federal salaries. The following is an excerpt from that statement:

"Our Society believes that federal-pay scales for engineers should be maintained at levels comparable to those prevailing in private practice. We likewise recognize the necessity of adjustments of pay scales so that increases in pay may bear a fair relationship to increases in responsibility as an employee advances in the government service. We favor legislation authorizing changes in compensation which would provide larger increases for those in the higher grades of the Classified Civil Service. . . .

"We believe that H.R. 8093 and the recommendations concerning pay scales of the Civil Service Commission represent a fair approach to the problem of salary adjustment, and we desire to record our support of the salary schedule in that bill. Possibly further adjustments will be desirable later, but we believe that the enactment of a bill such as H.R. 8093 would be a splendid accomplishment for the 83rd Congress."

At present there is a real need to provide incentives for engineers in the higher grades to remain in government and to accept added responsibilities, as well as to provide an incentive that younger engineers in government service may need as an inspiration to devote their careers to the federal service through adequate rewards for devoted effort and successful accomplishment.

Amendment of the Atomic Energy Act

Engineers Joint Council submitted a statement to the Joint Committee on Atomic Energy in connection with the hearings to amend the Atomic Energy Act (June issue, page 75).

The chairman of the Sanitary Engineering Division of ASCE also submitted testimony, consistent with general Society policy, which dealt largely with the disposal of atomic wastes. He urged that the inherent responsibility of the states for the protection of health and the control of the disposal of radioactive wastes be specifically recognized in the Act, and that the Commission be authorized to delegage such responsibility to the States when they are ready to assume them.

In connection with providing for research, problems related to the protection of the population against the disposal of radioactive contaminants should be included.

"The Act should emphasize that the Atomic Energy Commission is authorized: (*a*) to use its facilities as necessary to resolve the sanitary engineering and public health problems incidental to the development and utilization of atomic energy, and (*b*) to mobilize and integrate the facilities of the state and federal public health services and of other appropriate agencies in the administration and application of the necessary protective measures."

Water Resources

The President has established a Cabinet Committee on Water Resources Policy, with the Secretary of the Interior as chairman. The Secretaries of Defense and Agriculture will also be full members. The Director of the Budget and the Secretaries of Commerce and of Health, Education and Welfare will also participate.

The committee will cooperate with the Hoover Commission and consider its recommendations. There will also be an Inter-Agency Committee on Water Resources on which there will be representatives of Interior, Agriculture, Commerce, Health, Education and Welfare, Department of the Army and Federal Power Commission in addition to some participation by the Department of Labor. It will require good coordination to prevent duplication of work or inconsistent findings.

The St. Lawrence Seaway

On June 9, the President signed an Executive Order designating the Secretary of Defense to direct and supervise the St. Lawrence Seaway Development Corp. (June issue, page 86). The detailed management of the corporation, however, is vested by the statute (P.L. 358) in the administrator of the corporation, who will be appointed by the President, by and with the advice and consent of the Senate.

The U.S. Supreme Court gave the New York State Power Authority final clearance for its $600 million hydroelectric power project on the St. Lawrence River, clearing the way for the joint power project and also for beginning construction of the Seaway. The Court rejected the appeal of a group of Lake Ontario Landowners from a lower court decision approving the project. The Federal Power Commission has licensed the project.

Pamphlet on Division of Responsibility

Through the efforts of the National Joint Cooperative Committee of ASCE and AIA with the participation of representatives of ASME, the American Institute of Landscape Architects, and other professional societies, a pamphlet entitled "Division of Responsibility Among the Design Professions" has been prepared. This pamphlet outlines the operations to be performed by each specialist on large projects involving various types of engineering and architectural work. This present pamphlet covers housing projects, institutional and governmental buildings. It has been approved by the Board of Direction. A copy may be obtained by any member on request to the Washington office of the Society (1026 17th St., N.W.).

Washington, D.C.
June 11, 1954

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NEWS BRIEFS . . .

Construction Activity Reaches New Peak in May

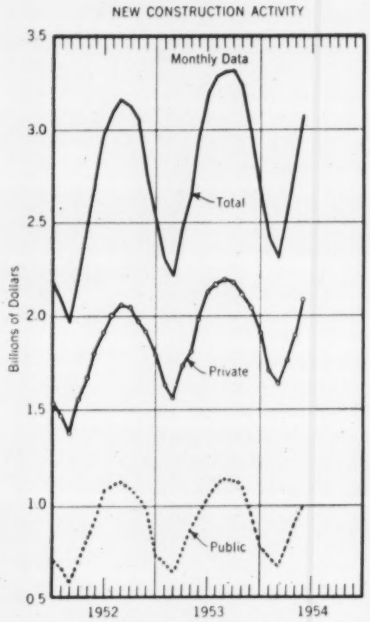
Expenditures for new construction, rising seasonally in May to a new record for the month of $3.1 billion, reached a peak of $13.2 billion for the first five months of the year, according to preliminary estimates of the Building Materials and Construction Division of the U. S. Department of Commerce and the Labor Department's Bureau of Labor Statistics.

Private spending for residential building exceeded $1 billion in May, after rising more than usual this spring, and commercial building reversed the downward drift of the past few months with a more than seasonal advance to an all-time peak for the month. On the other hand, expenditures for private industrial plant, which have been falling off gradually since early 1953, continued a slow decline, and in May were 14 percent below the level of a year ago. Aside from farm construction, this was the only major type of private construction activity to show any weakness so far this year.

All types of public construction except public housing contributed to the 13 percent rise from April in work financed by state, local, or federal government funds. Despite an abnormal amount of inclement weather, the advance in highway work was only a little less than seasonal, and accounted for most of the increase in public construction last month. Total public outlays for new construction amounted to nearly $1 billion, almost two-thirds of which was from state and local funds.

Expenditures for new construction as a whole have been exceeding the peak levels of 1953 each month, and by this May almost five years had elapsed (since mid-1949) without a single over-the-year decline.

The record level of expenditures so far this year is the result of unprecedented activity in construction of office buildings, shopping and service establishments, schools, churches, public utility and water and sewer lines, and roads and highways.



Total construction expenditures of $3.1 billion in May, representing an all-time peak for the month, are indicated in Department of Commerce curves.

In all these fields a backlog of need still exists, much of it in the many new communities that have developed in the postwar period. On the other hand, so far this year outlays for private industrial plant and for military facilities have been running at the lowest levels for the five-month period, and expenditures for conservation and development work (river and harbor, flood control and reclamation) and hospital building (private and public) have been at the lowest rate since 1949.

Supreme Court Upholds N.Y.C. Fight for Pure Water

New York City's long fight for an adequate supply of pure water from the Delaware River and its tributaries was won on June 7 when the U.S. Supreme Court approved a recommendation giving the city the right to an additional 360 mgd. In making the decision, the Court set aside a 1931 court decree, limiting the city to 440 mgd, and approved its request for ultimate use of 800 mgd. The decision was made on the recommendation of the Special Master in the case, Kurt F. Pantzer.

The petition for a change in the 1931 decree, which was made in April 1952, pointed out that in anticipation of the water needs after 1967, the city had prepared plans for a dam and reservoir on the West Branch of the river at Cannonsville. The proposed plan also includes the development of an additional 50 mgd from the Neversink and East Branch. The city will not be allowed to increase its diversion of Delaware River water to the full 800 mgd until completion of the Cannonsville project, estimated to be in about fifteen years. However, it will be able to increase its taking to 490 mgd when the Pepacton Reservoir on the East Branch is finished. Completion of this project is scheduled for early next year.

To meet the objections of three states (Pennsylvania, New Jersey, and Delaware) to the plea for more water, Mr. Pantzer said the amended court decree will leave the door open for future petitions to the Supreme Court. In addition, the court agreed to Mr. Pantzer's recommendation that a river master be designated by the chief hydraulic engineer of the U.S. Geological Survey. Under the recent Montague Plan, New York agreed to assure stabilized flow in the lower Delaware by releasing water from its reservoirs when needed.

WASHO Road Test Completed

Traffic on the WASHO Test Road in southeastern Idaho has been stopped, following the application of 238,000 heavy axle loads to each of the test pavements, according to an announcement from the Highway Research Board, which is conducting the test for the Western Association of State Highway Officials. Flexible pavements, pavements made up of gravel with asphaltic-concrete surfacing and varying in thickness from 6 to 22 in., were tested under 18,000- and 22,400-lb single-axle loads and 32,000- and 40,000-lb tandem-axle loads.

The project cost the eleven Western states participating and Alaska about $41,000 each. The balance of the cost (estimated to total $890,000) was contributed in the form of services, materials, and equipment by the Bureau of Public Roads, truck and truck-trailer manufacturers, and the petroleum industry.

Engineers engaged in the road test have begun detailed studies of the post-test condition of the pavement components down to the subsoil. A final report containing the results of condition tests and an analysis of all data taken on the WASHO Road Test will be published by the Highway Research Board after the studies have been completed, probably in the spring of 1955. Many of the data relating specifically to the design and construction of the test road and the procedures used in testing and instrumentation are now available in the Board's Special Report 18 under the title, "The WASHO Road Test—Part 1: Design, Construction, and Testing Procedures." Inquiries about Special Report 18 should be sent to the Highway Research Board, Washington, D.C.

Company Formed to Make Concrete Pipe and Piles

The Raymond Concrete Pile Co. and the Morrison-Knudsen Co., Inc., have formed the Cen-Vi-Ro Pipe Corporation for the manufacture and installation of concrete pipe made by the Cen-Vi-Ro method. In addition, the Raymond company has acquired exclusive license to make piles by the Cen-Vi-Ro process all over the world. The new organization will be managed jointly by officials of the two companies, in association with George R. Jessen, of Salt Lake City, developer of the process. Manufacturing plants will be located at Oxford, Nebr., and Morgan City, La.

The Cen-Vi-Ro process derives its name from the method of molding the pipe, in which three forces are applied simultaneously—that is, the concrete is pressurized by centrifugal force, subjected to high-frequency vibration, and compacted with a steam roller. Extremely low-slump concrete is used. The pipe is ready for installation the day after it is molded. A rubber - gasket - sealed bell - and - spigot joint forms a watertight seal against joint leakage or external filtration, eliminating the need for further sealing of the joint by mortar.

The process is adaptable to making all types of concrete pipe, including sewer culverts and high- and low-pressure pipe. Pipe made by the process is said to be strong, dense, and impermeable. It will be available in diameters up to 84 in., in lengths from $7\frac{1}{2}$ to 12 ft.

Concrete Board Dines at Bottom of Hudson

At the New York Concrete Industry Board's last meeting of the year, members met for lunch inside one of the large concrete boxes which support Pier 57 (March 1952 issue, p. 36), at present under construction. Roger Corbetta, of the Corbetta Construction Co., chairman of the meeting, told the group that there was 6 ft of water above the 18-ft ceiling.

Speaker for the session was Waldo E. Bowman, editor of *Engineering News-Record*. In speaking of the job before the CIB in improving the quality of concrete, he stated that "The concrete industry has done a magnificent job in continuously raising the standards of high-quality concrete, but has largely neglected the equally important job of lifting probably half of its production above the level of mediocrity. It is concentrated on research, to make a superior product possible, but has slighted the other angle of actual practice; in other words, the results of the research to be followed generally in ordinary practice."

Mr. Bowman said, in summary, "What you're really espousing is honest concrete—honest in proportions, honest in manufacture, honest in placement. In total, honest in quality."

At the conclusion of the meeting those interested were conducted on a tour of the pier, whose 94,000-ton cargo capacity is twice that of conventional piers of the same length.

AIEE Elects New Officers

Election of A. C. Monteith, vice-president in charge of engineering and research for the Westinghouse Electric Corp., Pittsburgh, was announced at the recent opening session of the five-day Summer and Pacific General Meeting of the American Institute of Electrical Engineers in Los Angeles. Mr. Monteith, who succeeds Elgin B. Robertson, of Dallas, Tex., will take office for a year on August 1.

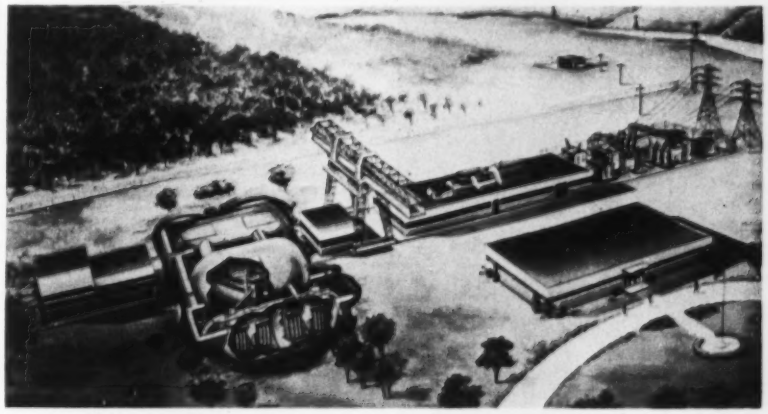
Newly elected vice-presidents are G. J. Crowdes, Cambridge, Mass.; J. P. Newbauer, New York City; Claude M. Summers, Fort Wayne, Ind.; S. M. Sharp, Shreveport, La.; and John R. Walker, Billings, Mont. Walter J. Barrett, of Newark, N. J., was reelected treasurer for a year.

Contract Let for Turnpike Bridge Over Delaware

Work on the new bridge across the Delaware River to connect the New Jersey and Pennsylvania turnpikes will get under way soon, following award of a $3,688,223 low-bid contract for construction of the substructure to the Merritt-Chapman & Scott Corp. The 6,571-ft, six-lane bridge will connect the toll roads near Florence, N.J., and Edgely, Pa. It was designed by George S. Richardson, of Pittsburgh, who will serve as consulting engineer during construction. The structure is a joint project of the New Jersey Turnpike Authority and the Pennsylvania Turnpike Commission.

The substructure contract will include construction of 30 twin-shafted piers of reinforced concrete, two in the river and 28 ashore, and two abutments. The portion of the bridge over the shipping channel will consist of a three-span continuous arched truss with a center span of 682 ft flanked on both sides by 341-ft spans. The fixed span over the shipping channel will provide a minimum vertical clearance of 135 ft above mean high water and a horizontal clearance of 636 ft.

Atomic Power Station to Be Built Near Pittsburgh



Nation's first central station atomic power plant, which is to be built at Shippingport, Pa., as a joint project of the U.S. Atomic Energy Commission and the Duquesne Light Co., is shown in artist's sketch. Westinghouse Electric Corp. is building the reactor portion of the plant under contract to the AEC. Architect-engineer services will be performed by Stone & Webster as the subcontractor under Westinghouse, with reimbursement to be for actual costs from government funds plus a fee of $1 for services rendered. The Duquesne Light Co. will design and construct the turbine generator portion and will operate the entire plant. Plant components pictured are (reading from the left): building for fuel handling; atomic reactor and heat exchangers; maintenance building and overhead traveling crane; turbo-generator building; switchyard containing transformers and circuit breakers; and transmission lines.

Contract Given for Labrador Air Base

To complete remaining work on the Goose Bay, Labrador, air base, the Army Corps of Engineers has awarded a $24,599,966 contract on a fixed-price basis to the Merritt-Chapman & Scott Corp. and Johnson Drake & Piper, according to an announcement from Brig. Gen. Robert G. Lovett, Army East Ocean Division Engineer. Work to date on the Goose Bay air base has been performed by these two companies as a joint-venture contract on a cost-plus-fixed-fee basis.

In announcing the change from a cost-plus-fixed-fee contract to a fixed-price contract, General Lovett said, "This conversion is in line with the Corps of Engineers policy of using fixed-price contracts wherever possible. Cost-plus-fixed-fee contracts in certain remote locations have been necessary because of the hazards and uncertainties of working in strange foreign areas of severe climatic conditions, and because of the frequent necessity—in the urgency of defense construction—of starting actual work while overall plans were still incomplete."

General Lovett estimates that the change in the present contract will effect a saving of approximately $2,000,000 in the overall cost of the project. Total cost of the base and two other Canadian installations in the contract will be $99,900,000.

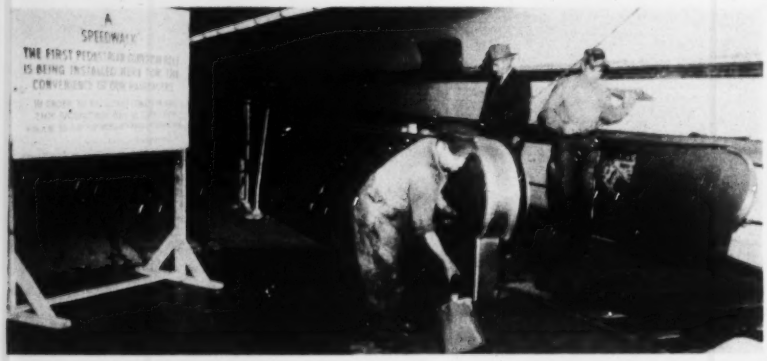
Moving Sidewalk Installed in Jersey City Station

A fifty-year dream of transit authorities came true on May 24 when the world's first passenger belt conveyor was placed in operation in the Erie Station in Jersey City, N.J. Installed by the Hudson & Manhattan Railroad in its Erie tube station, the new "Speedwalk" carries homeward-bound New Jersey commuters a distance of 227 ft up an inclined ramp leading to the Erie Railroad terminal.

The moving rubber belt passenger conveyor negotiates a 10 percent grade for the first 137 ft. It operates at a speed of 120 fpm, delivering passengers who walk along its moving surface to the end of the ramp in 35 seconds, compared with a normal upgrade walking time of 55 seconds through the regular passageway. Capacity is 18,000 passengers an hour in a single direction. For the present the belt, which is reversible, will be operated between the hours of 7 a.m. and 7 p.m., upgrade only.

A 20-hp electric motor drives the belt, which rides along a bed of closely spaced steel rollers or idlers. Manufactured as a single unit 460 ft long, the belt is 5½ ft wide and ⅝ in. thick. The two ends were vulcanized together after the belt was threaded through the end pulleys and placed on the conveyor frame work.

The "Speedwalk" was designed by the Goodyear Tire and Rubber Co., and fabricated by the Stephens-Adamson Manufacturing Co. About a month was required for installation.



Process of installing moving pedestrian sidewalk in Erie Station in Jersey City, which required about a month, is depicted in large view. Small view shows finished structure, which was opened to traffic on May 24.

Army Consolidates Its Division Offices

Because of reduced workload the Army Corps of Engineers is consolidating its Upper Mississippi Valley Division at St. Louis and its Great Lakes Division at Chicago into a new North Central Division, with headquarters in Chicago. The Rock Island (Ill.) and St. (Minn.) Districts will be placed under the new North Central Division. The St. Louis District Office will be placed under the Lower Mississippi Valley Division, which has its headquarters at Vicksburg, Miss. The consolidation will be completed by September 1.

The East Ocean Division, with headquarters in Richmond, Va., will be closed when the current building season is over and remaining work will be transferred to the North Atlantic Division office in New York City. The East Ocean Division was created in 1951 for the specific purpose of supervising the construction of airfields and airbase installations in Canada, Iceland, Greenland, Bermuda, and the Azores.

Iron-Ore Production At New High in 1953

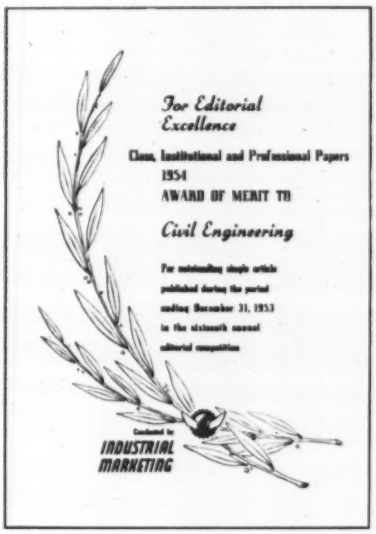
More iron ore was produced in the United States during 1953 than ever before, and a record was also set in imports of ore to this country, according to an announcement from the American Iron and Steel Institute. Figures based on government reports indicate that domestic production was 133.5 million net tons, which exceeded the previous record high (set in 1951) by about 3 million tons. Imports totaled 12.4 tons, nearly 1 million tons more than the record set two years ago.

In this country, the Lake Superior iron-ore ranges accounted for slightly more than 80 percent of total iron-ore production. Among individual states the largest producers were Minnesota, Michigan, Alabama, Utah, and New York, in the order named. Taconite, the comparatively low-grade, hard ore surrounding the richer deposits in the Lake Superior area, came in for considerable development during the year. A major plant under construction at Beaver Bay will produce 3.75 million tons of concentrate a year. A smaller taconite-processing plant went into production at Iron Mountain in June, and construction of a plant at Aurora will start in 1954.

The major source of foreign iron ore in 1953 was Chile with 2.65 million tons. Next was Sweden, the leading source in 1952. More than 2 million tons was obtained from both Venezuela and Canada, and Peru was fifth with about 940,000 tons. All except Sweden have been assisted in their ore development by the United States.

"Civil Engineering" Receives Editorial Award

"Civil Engineering" receives the 1954 Award of Merit for "editorial excellence" in the sixteenth annual editorial competition conducted by Industrial Marketing. The award, given in the class of "Institutional and Professional Papers," is made for the "outstanding" single article published during the period ending December 31, 1953. The "outstanding" article—"Precast Concrete Offers New Possibilities in Design of Shell Structures" by Pier Luigi Nervi and translated by L. P. Corbetta—appeared in the February 1953 number.



Engineer Fined for Work Without License

For performing civil engineering work without a license Karel Kooper, of Los Angeles, has been fined $500 and placed on probation for two years. The punitive measures, levied by Judge James M. McDonnell, of Sacramento, also included a six-month suspended jail sentence and the censure of the court.

According to special investigators for the Board of Registration for Civil and Professional Engineers and the Board of Architectural Examiners, Mr. Kooper performed civil engineering, supervisory, and architectural services on construction of the big Sutters, Fort, and Riverpark shopping centers at Sacramento. He prepared all structural drawings, specifications, and estimates. The case came to the attention of the investigators in the form of numerous complaints from architects and engineers in Sacramento

Waterways Experiment Station Observes 25th Anniversary

Thousands of visitors from all over the country inspected the Waterways Experiment Station at Vicksburg, Miss., during an Open House held on June 18, 19, and 20 to observe its silver anniversary. Guests included Maj. Gen. Samuel D. Sturgis, Chief of Engineers, and some of the country's leading scientists and engineers. In the brief period of a quarter of a century, the Experiment Station has grown from a small hydraulic laboratory, devoted exclusively to hydraulic experimentation and flood control studies for the Lower Mississippi Valley, into the principal research and experiment facility of the entire Corps of Engineers in the fields of hydraulics, soils mechanics, flexible pavements, and concrete.

The Station's Hydraulics Division, headed by Eugene P. Fortson, Jr., M.ASCE, is organized into three specialized branches: the Rivers and Harbors Branch devoted to navigation and flood control on inland rivers and estuaries; the Hydrodynamics Branch, concerned with the hydraulic appurtenances for harbors on exposed coasts; and the Hydraulics Analysis Branch for field and office testing of hydraulic structures in operation, and for devising design criteria. The largest hydraulic laboratory in the world, the installation includes a 200-acre Mississippi Basin Model at the Station's suboffice near Jackson, Miss.

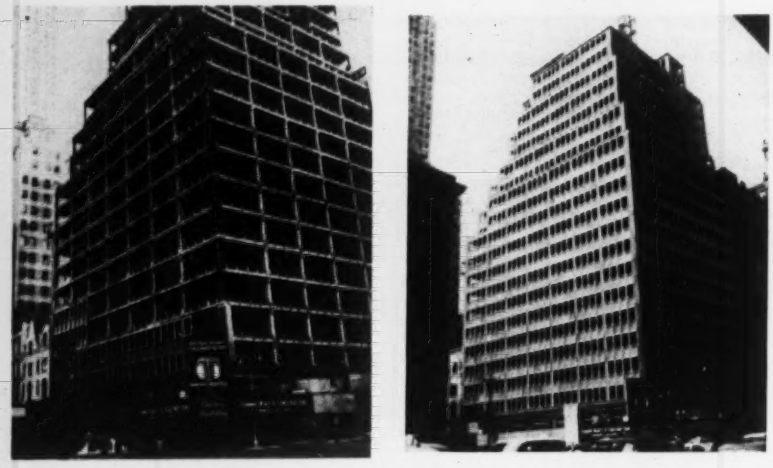
About sixty investigational projects are under way at one time. Projects currently being studied include spillways and outlet works for the big Missouri River dams, navigation locks and dams on the Ohio River, the Delaware River, Charleston Harbor, Niagara River, and the diversion of the Mississippi through Old River.

The work of the Concrete Division, under Herbert K. Cook, is threefold in nature. First, as a laboratory for the Lower Mississippi Valley Division of the Corps of Engineers, it conducts schools for concrete inspectors and samples and tests cement and curing compounds. Second, as one of three Corps of Engineers laboratories staffed and equipped for sampling and testing concrete, it serves a number of military airfield construction projects in the South and Southwest. In its third and most important capacity, the Division serves as concrete research laboratory for the entire Corps of Engineers, assuring tremendous savings to the taxpayer on major construction projects.

The work of the Soils Division, headed by Willard J. Turnbull, M. ASCE, falls into three principal categories: (1) analysis and design of earth foundations and research work in connection with soil mechanics; (2) development of criteria and methods for design and construction of flexible pavements for all types of military aircraft; and (3) investigation of the ability of natural soils to support the movement of military vehicles.

View of portion of Mississippi River flood control model, showing Morganza and West Atchafalaya floodways in operation. These floodways divert a large portion of Mississippi River floodwater through the Atchafalaya Basin.

Aluminum Facing Placed in Less Than Ten Hours



Before and after construction views of a 22-story New York office building taken ten hours apart show speed with which aluminum facing can be placed. Starting at 6:02 a.m., workmen completely covered two faces of the structure in 9 hr and 58 min. Photo (left), taken early in morning, shows steel brackets (welded to the structural frame), to which two-story aluminum panels were bolted. By 4 p.m. (photo right), 676 panels had been placed by six crews of six men each, working within the building and using no exterior scaffolding. Each panel weighs about 200 lb and is 4½ by 23 ft by ⅛ in. thick. Two windows in each panel are vertically pivoted to permit interior cleaning of both sides of pane. To provide weather tightness, the panels are joined by interlocking flanges which completely eliminate the need for caulking. The building is being constructed by the Tishman Realty and Construction Co., of New York. The panels were provided by the General Bronze Corp., of Garden City, N.Y.

Nuclear Notes

III—Structure of the Atom

"Nuclear Notes" are prepared for the Sanitary Engineering Division by its Committee on Sanitary Engineering Aspects of Nuclear Energy, which is headed by Conrad P. Straub, of the Oak Ridge National Laboratory, and includes S. T. Barker, A. E. Gorman, Prof. Warren J. Kaufman, and James G. Terrill, Jr. Next month's subject will be: "Nuclear Particles and Rays."

When asked how many elements are known, we will search back to our knowledge of elementary chemistry and reply that there are probably 92. This flashback may call to mind some ideas about the Periodic Table. We may remember that the Periodic Table showed the known elements and also served as a means of indicating possible missing elements. Early study of the subject indicated two missing elements which have since been found (No. 85, astatine, and No. 87, francium), and the entire system has been extended and now includes a total of 100 elements (No. 93, neptunium; No. 94, plutonium; No. 95, americium; No. 96, curium; No. 97, berkelium; No. 98, californium; and Nos. 99 and 100). Nos. 99 and 100 have been reported since the preparation of the original draft of this material and have not been named as yet. The entire series from 93 through 100, products of the atomic age, have been placed in the actinide series along with actinium, thorium, protactinium, and uranium, and form a series which is analogous to the lanthanide or rare earth group of elements.

With our inventory of the known elements brought up to date, we shall consider the constituent parts of the atom, which is the basic unit of matter. It may be pictured as a miniature solar system with a nucleus resembling our sun and orbital electrons analogous to planets. Although this concept is valid, we soon learn that the nucleus is not a single particle, but is made up of two kinds of particles—namely, protons or positively charged particles with a mass of 1.6729×10^{-24} grams and neutrons or uncharged particles of mass 1.6751×10^{-24} grams. The electrons, which are found outside of the nucleus in orbits or shells, are negatively charged particles with a mass of 9.1055×10^{-28} grams. Thus it will be seen that the electrons have a mass approximately 1/1800 of that of protons or neutrons, and that the neutron is the heaviest particle found in the nucleus.

Atomic nomenclature indicates that atoms of the elements can be represented as follows: ${}_{Z}X^{A}$, where Z is the atomic number of element X (also equal to the number of protons in the nucleus), and A is its mass number (equal to the sum of the protons and neutrons in the nucleus). Thus, an atom of hydrogen would be written as ${}_{1}H^{1}$, which means that the hydrogen atom has a mass of approximately one (in terms of mass units), and an atomic number of one (charge of plus one). Deuterium contains a hydrogen atom represented as ${}_{1}H^{2}$, which has a mass of two units and an atomic number of one (charge of plus one). Similarly, a tritium atom is written as ${}_{1}H^{3}$. In each of these examples (${}_{1}H^{1}$, ${}_{1}H^{2}$, and ${}_{1}H^{3}$), the neutral hydrogen atom contains one proton in the nucleus (therefore a charge of plus one) and one electron outside, but, ${}_{1}H^{2}$ has a neutron and ${}_{1}H^{3}$ two neutrons in the nucleus in addition to the proton. Thus the difference in these three hydrogen atoms is the number of neutrons found in the nucleus, which modifies the weight of the atom. Here we have hydrogen atoms containing zero, one, or two neutrons, respectively. The difference N–Z between the number of neutrons, N, and protons, Z, in a nucleus is referred to as the neutron excess, and the sum of N + Z equals the mass number A.

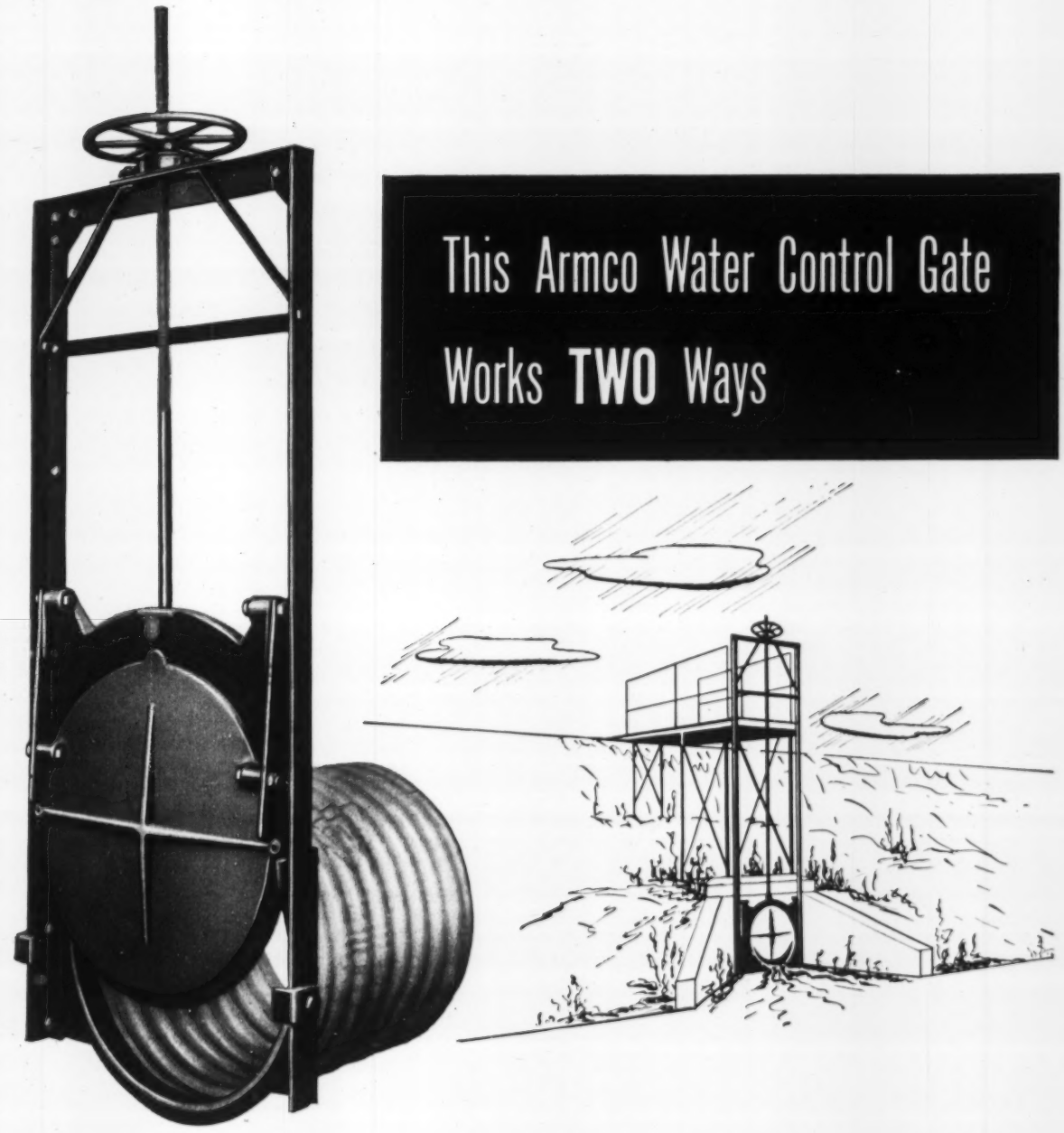
All the hydrogen atoms defined in the foregoing have the same chemical properties but differ only in mass (because of the number of neutrons in the nucleus). Atoms of the same atomic number but with different mass numbers are called isotopes. Some isotopes may be radioactive, others stable. Thus ${}_{1}H^{1}$ and ${}_{1}H^{2}$ are the stable isotopes of hydrogen and ${}_{1}H^{3}$ is the radioactive one. Radioactive isotopes will be discussed in subsequent articles.

Helium, the next atom in the Periodic Table, contains two protons and two neutrons, in the nucleus and two orbital electrons, and is written ${}_{2}He^{4}$ with a weight (in terms of mass units) approximately four times that of ${}_{1}H^{1}$. It is stable. Another stable isotope of helium is ${}_{2}He^{3}$ which is composed of two protons and one neutron. This isotope differs from ${}_{2}He^{4}$ in that it contains only one neutron in its nucleus and has a mass approximately equal to ${}_{1}H^{3}$. In addition to this stable isotope, helium has two very short-lived radioactive isotopes, ${}_{2}He^{5}$ and ${}_{2}He^{6}$. In a similar manner we could continue through the rest of the elements listed in the Periodic Table. Some elements have a large number of isotopes, others have only a few. In the case of tin, for example, nineteen isotopes are listed ranging from ${}_{50}Sn^{109}$ to ${}_{50}Sn^{128}$.

The neutron is also written in terms of the above nomenclature as ${}_{0}n^{1}$.

[*Suggested outside reading: Chapters I, II, and IV, "Sourcebook on Atomic Energy," by Samuel Glasstone. D. Van Nostrand, Inc., New York (1950). Chapter XXIII, Atomic Structure, "Outlines of Theoretical Chemistry" 6th edition, by Frederick H. Getman and Farrington Daniels, John Wiley and Sons, Inc., New York (1937).*]

This Armco Water Control Gate Works **TWO** Ways



It combines the features of a flap gate and a slide gate. As a self-operating flap gate, it lets water out, but shuts the door on backwater. As a slide gate, it can be opened and closed manually to let water go either way.

Chances are there is an Armco Gate with the features or combination of features to fit *your* water control needs. They are available in a wide range of sizes and types. There are Armco Slide Gates for light and heavy duty, capable of withstanding face pressures from a few feet up to 50 feet. Flap Gates are available for circular openings up to 120 inches in diameter and for rectangular openings up to 96 inches square. Armco Radial Gates are supplied in widths up to 30 feet. Other types include Meter Gates and Roller Bearing Gates—all available from one source.

For complete information about the Armco Gate that meets your water control needs, write us, outlining your problem. Armco Drainage & Metal Products, Inc., 4314 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

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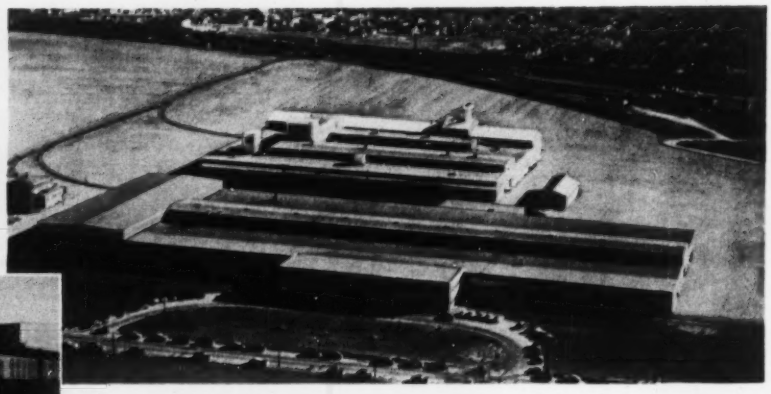
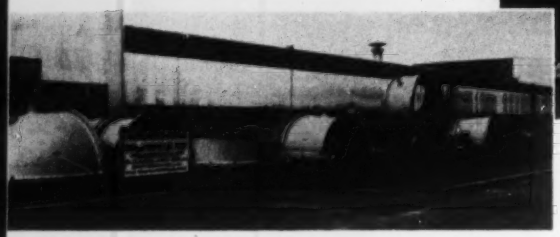
WATER CONTROL GATES

Fairbanks-Morse new Kansas City Pump Works (right) occupies 38 1/2-acre site in Santa Fe Industrial District of the Sunflower State. Smaller view shows one of six 116-in. propellor pumps loaded on three flat cars for delivery to Corps of Engineers in Florida. Fairbanks-Morse also has order for three 144-in. models to be installed by Army engineers for drainage of Lake Okeechobee region.





Fairbanks-Morse Dedicates Kansas City Pump Plant

During a recent two-day show for a thousand engineer guests, Fairbanks-Morse dedicated its new $6,000,000 pump and engine manufacturing plant located on a 38 1/2-acre site in the Santa Fe industrial District of Kansas City, Kans. Company confidence in the location is indicated by its construction of the plant in the area which suffered from the devastating flood of 1951 when the Missouri and the Kansas rivers spilled over the region. Gov. Edward F. Arn was the principal speaker, welcoming the company, headed by Robert H. Morse, Jr., to the impressive roster of industries being attracted to the area.

The highly mechanized 320,000-sq ft plant is complete with cupolas, electric furnaces, pattern shops, a foundry capable of casting 82 tons of castings a day, machine shops for mass production operations, assembly lines, a pump-testing floor, and crating and shipping facilities. Annual capacity of the plant is said to be enough pumps to move 35,000 mgd of water or other pumpable fluids. An exhibition of bladeless centrifugal pumps handling citrus fruit, live fish, golf balls, and overalls without damage to the pump or materials pumped attracted much attention. The Fairbanks-Morse line of pumps ranges from 3/4-in. models to the four 144-in., 400,000-gpm drainage pumps, for which the Corps of Engineers has just contracted for use on the Lake Okeechobee project in Florida. These big pumps costing $200,000 each, will be housed in weldments.

Another part of the two-day show brought into forum session some of the nation's top hydraulics experts in pump design and use. L. H. Kessler, A.M. ASCE, chief engineer of Fairbanks-Morse, played a major part in arranging the pump forum. ASCE Director Francis M. Dawson, dean of the University of Iowa College of Engineering, was the presiding officer. "Civilization depends on pumps," he said, "for water, sewage, automobiles, engines, airplanes. Reliability is more important than efficiency. One outage could cost more than the savings resulting from high efficiency."

Speaking of the role of research in the future of the hydraulic engineer, Dr. Richard G. Folsom, director of engineering research, University of Michigan, observed that research is recognized as important to industry, and accounts for 1 to 2 percent of the cost of the product, but warned that our stockpile of ideas is dangerously low. More college students must become interested in engineering research.

In the large irrigation pump field Ireal A. Winter, chief of the Hydraulic Machinery Branch of the U. S. Bureau of Reclamation, described the 144-in. pumps at the Grand Coulee Dam —each of 1,600-cfs capacity and operated by 65,000-hp motors, which operate at maximum efficiency of 93.9 percent. "Pump sizes are limited only by the size of available forgings for shafts," he said. In the field of flood control and drainage pumps,

Speakers at Fairbanks-Morse Hydraulics Forum on Centrifugal Pumps are (seated, left to right, left-hand photo): Prof. Philip F. Morgan, University of Iowa; Moderator Robert T. Knapp, Cal Tech; Chief Engineer L. H. Kessler: Ireal A. Winter, USBR; Dr. George F. Wislicenus, Johns-Hopkins; and Dr. James W. Daily, MIT. Standing, in same order, are Dan R. Rankin, Food Mechinery and Chemical Corp.; Dean Francis M. Dawson, University of Iowa; Dr. Richard G. Folsom, University of Michigan; Gail A. Hathaway, Past-President of ASCE; Clement P. Lindner, Corps of Engineers; and Prof. Aladar Hollander, Cal Tech. In view at right President Robert H. Morse, Jr., and Dean Dawson, who presided, make final plans for the forum.

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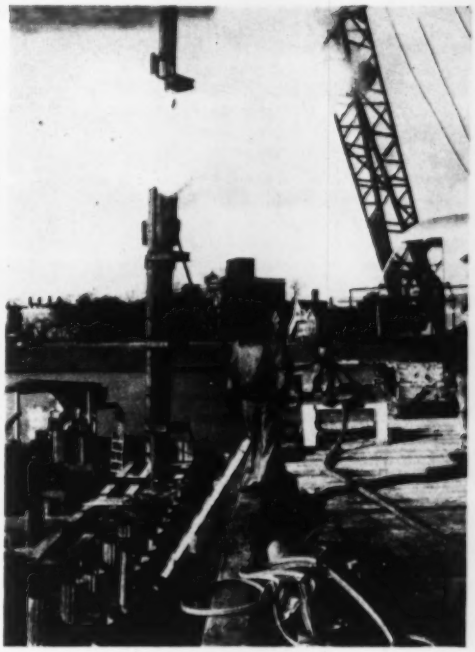

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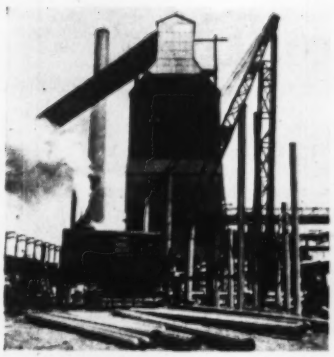
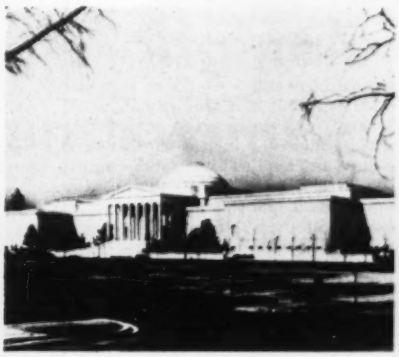
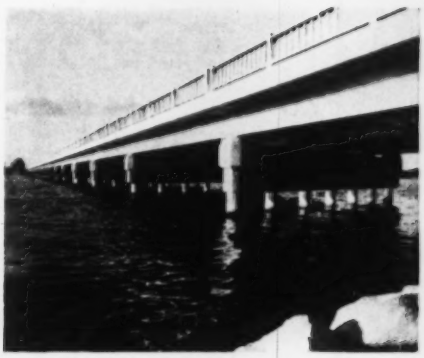


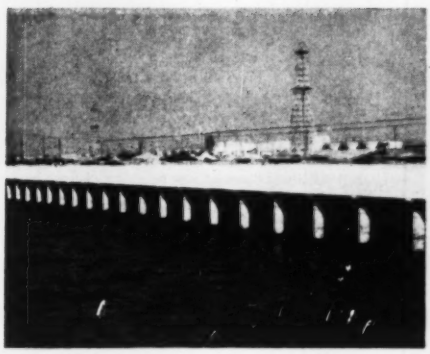
INDUSTRIAL PLANTS



BUILDINGS



BRIDGES



PIERS

RAILROAD STRUCTURES

EXPRESSWAY OVERPASSES

UNION METAL

Monotube Foundation Piles for every foundation problem

Clement P. Lindner, M. ASCE, chief engineer, South Atlantic Division of the Corps of Engineers, stated that the Corps does not hesitate to design pumps of 120-in dia and that bigger models—144 to 160-in. dia—are in demand.

Deep-well pumps, 600 to 1,000 ft deep, with driving motors on the surface give trouble because of stretch in the long line shaft. "The trend is toward submersible motors mounted below the pump bowls," said Don R. Rankin, chief engineer of the Peerless Pump Division of the Food Machinery and Chemical Corp.

In designing pumps for handling mixtures of water and solids, Philip F. Morgan, M. ASCE, professor of sanitary engineering at the University of Iowa, pointed out that friction losses for sewage sludge and paper stock may be 30 times that of water alone. Grit and grease further complicate the problem. Cut-and-try methods are necessary in developing pumps to move these materials.

Prof. Aladar Hollander, of the Hydrodynamic Laboratory at the California Institute of Technology, observed that while engineers have learned a lot about the behavior of water in pumps, real knowledge is still lacking. "The water knows much more about what it is doing than we do," he said. Dr. Hollander admitted that the United States is ahead of the rest of the world in the field. Submersible motors for deep-well pumps, for example, have been built to operate for at least five years without major attention.

To obtain high efficiencies over a wide operating range, adjustable guide vanes need to be considered, commented Dr. George F. Wislicenus, chairman of the mechanical engineering department at Johns Hopkins University.

In summing up the panel presentations and discussion, Moderator Robert T. Knapp, M. ASCE, professor of hydraulic engineering at California Institute of Technology, expressed his belief that pump users must take over from industry a greater share of the burden of research if needed progress is to be made in pump development.

Following the hydraulics forum, the visiting engineers and the company's management and employees had lunch together to hear a talk by Gail A. Hathaway, Past President of ASCE and special assistant to the Army Chief of Engineers, on the problems caused by the increased demand for water in the United States and on the steps being taken to assure an adequate supply for the future. "Our greatest problem is the maldistribution of water both as to time and geographic areas," Mr. Hathaway said. While irrigation accounts for more than half of the water consumed in the United States, it is well to note that industry is a close second. It takes 18,000 gal of water to make a ton of ingot iron, and another 65,000 gal to convert a ton of iron into steel. A ton of coke requires 3,600 gal. "Future water needs must be supplied by recirculation, reclamation of used water, and better use of existing supplies," he noted. "Although about 170,000,000 acre-ft of reservoir storage has been developed in the United States, further regulation of streams by storage may provide a large part of our expanding needs. There is urgent need for a sound national policy for the development and conservation of our water resources."

Fairbanks-Morse looks forward to future hydraulics forums not sponsored by any industry.

N. G.* Neare's * COLUMN

R. ROBINSON ROWE, M. ASCE

"Were you joshing?" asked Joe Kerr.

"Was who joshing whom?" quipped Professor Neare with a quid pro quo.

"Were you joshing Cal and me, I wonder, when you asked if Mac McMack was a good buyer when he got pentagonal tile for $4/M instead of hexagonal tile at $6.25? It seems so simple."

"How simple?"

"Well, you said each had 5/8-in. edges, and since the area of a regular polygon of n sides s is $\frac{1}{4}ns^2 \cot \pi/n$, the relative areas of the two kinds of tile was

$$\frac{5 \cot 36^\circ}{6 \cot 30^\circ} = 0.662212$$

Since this exceeds 0.64, the ratio of prices, it was a good deal."

"Now I'm wondering," mused Ken Bridgewater. "I'm wondering if Joe ever tried to lay a bathroom floor with pentagonal tile. The best you can do, you have the cutest little rhombi left over. Maybe Joe could dissect 15 percent of his tiles into little pieces that would fit into the rhombic gaps, but he'd soon tire of such a bargain.

"Then again, I'm wondering if the specified 'close fit' implied some other shape. An equilateral pentagon would fit in a pattern if made of a square and a projecting or reentrant triangle, for which shapes Joe's formula would become

$$\frac{4 \cot 45^\circ \pm 3 \cot 60^\circ}{6 \cot 30^\circ} = 0.5516 \text{ or } 0.2182$$

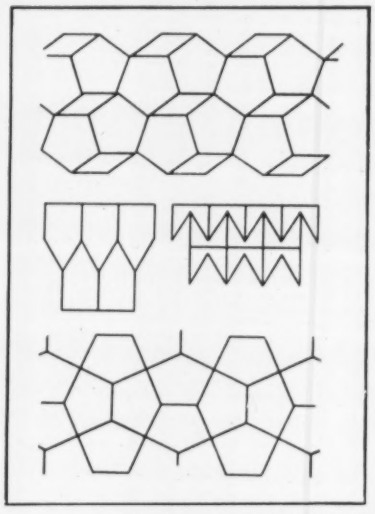


Fig. 1. Equilateral pentagonal tile needs rhombic fillers if regular and belt patterns if shaped like squares with projecting or reentrant triangles (center), but the oblate form (bottom) lays in an esthetic pattern of intersecting hexagons.

Since neither equals 0.64, it was a deplorable deal."

"Ken's in the right lane," admitted Cal Klater, "but he should have kept on wondering. The Professor called Mac his 'close friend', but if Ken were right, he lost nearly 14 percent, which isn't close at all. There's still one more equilateral pentagon which fits in a plane pattern and not having an acute angle, has a larger area. Its two right angles are not consecutive, but it is symmetrical with an angle of $\sin^{-1} 0.75$ at the apex. With an area of $\frac{1}{4}\, a^2(4+\sqrt{7})$ which is 0.63949 times that of the hexagon, it was a poor deal, but a close one."

"And that," beamed the Professor, "is exactly the tile that was not needed in the Pentagon Building. I like the pattern so well that I have a hunch that Mac knew his closeness was on the wrong but artistic side. So, with that I'll take a vacation, but to keep the rest of you out of mischief, I've invited Professor Sauer Doe to mete out the next assignment."

"Its something that came to me," explained Professor Doe, "when I was building a lanai in my patio. I had ripped a 4 × 4 redwood post diagonally so as to get two equal tapered pieces with a 4-in. knife edge at one end and a 4 × 4 butt at the other. Just for ducks I balanced one in a teetering position on a wire clothesline. How far must it have been from the wire to the butt end?"

[Joe Kerrs were too numerous to mention. Cal Klater was Thomas Ogburn III, and Kens were S. K. Rueball (Keith Jones), Robert W. Woodbury, Count Harvey, and Don'T (Don Thayer). Guest Professor Sauer Doe is Marvin Larson]

Tracing design on glass cloth from metal loft at A. O. Smith Corp., Rochester Works.

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At the A. O. Smith Corp.'s Rochester (N.Y.) Works, large drawings are made exactly to scale on glass cloth. Since these drawings often cost several hundred dollars each, A. O. Smith naturally does not wish to expose them to possible damage during print-making and to the wear and tear of excessive handling. Instead, they use intermediates made on Kodagraph Autopositive Paper.

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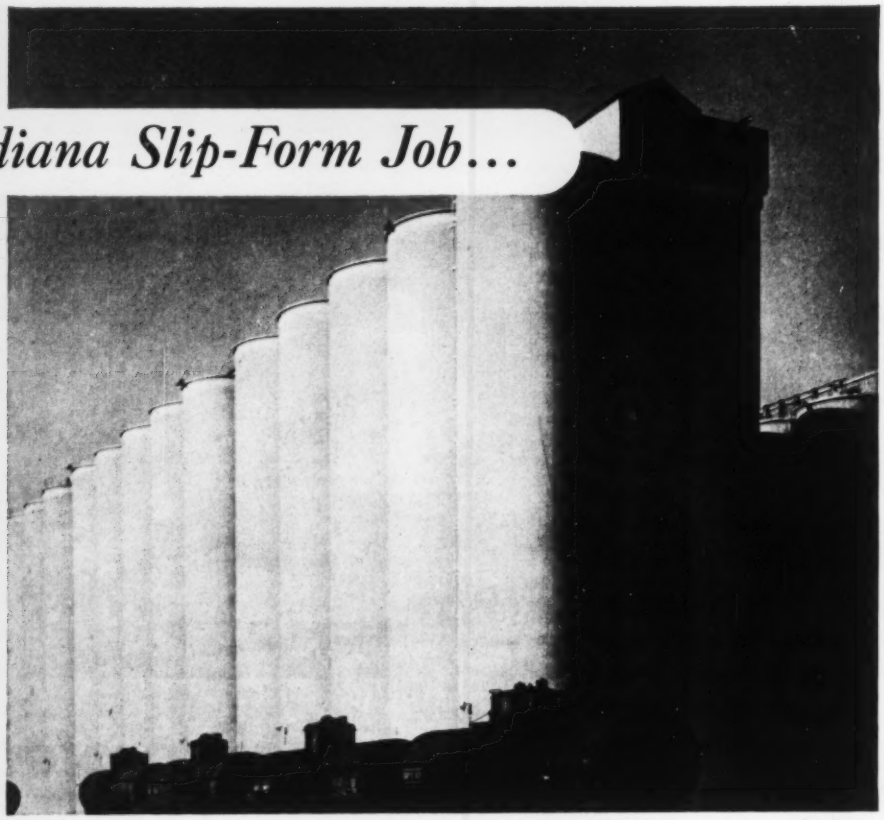

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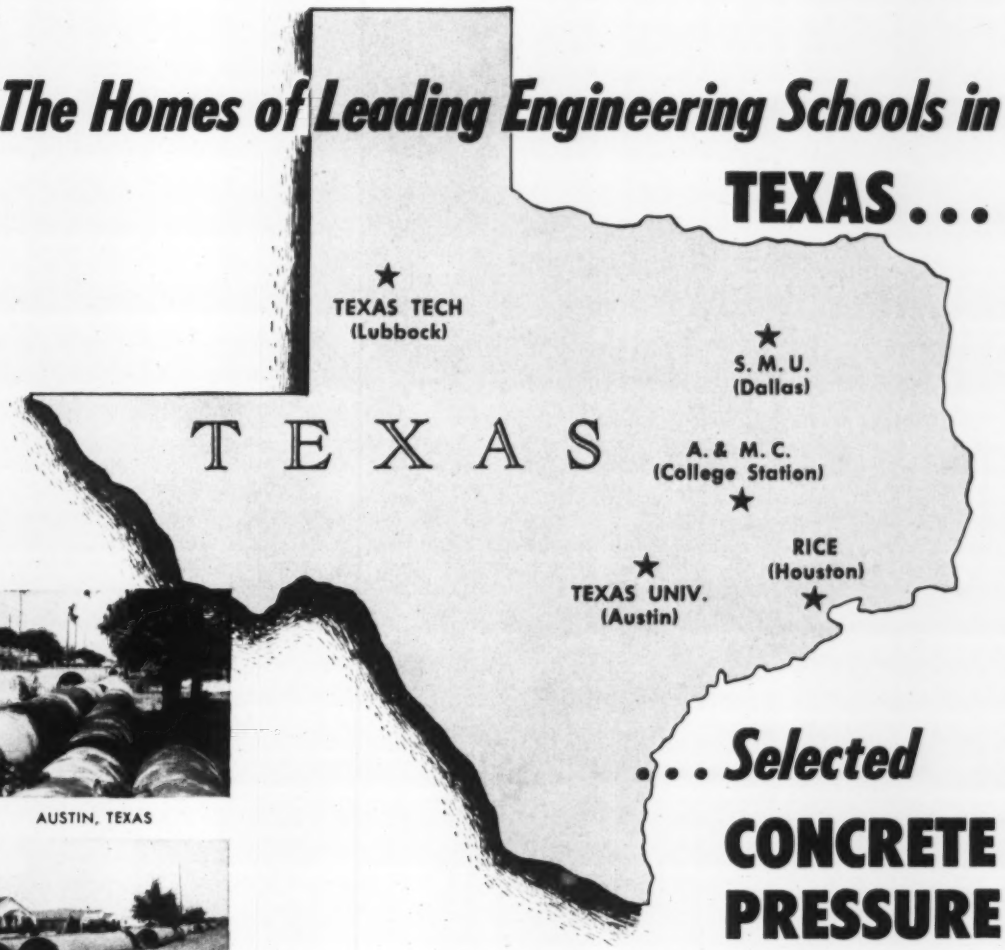
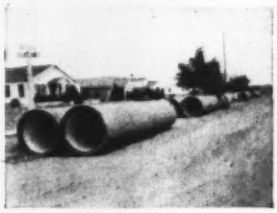


AUSTIN, TEXAS



LUBBOCK, TEXAS

COLLEGE STATION, TEXAS

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WATER FOR GENERATIONS TO COME

Delaware Water Gap Bridge viewed from the air from the Pennsylvania side. Owner: Delaware River Joint Toll Bridge Commission. Prime Contractor: Johnson, Drake and Piper, Inc., New York. Consulting Engineer: J. E. Greiner Co., Baltimore. Steel Fabricator and Erector: Bethlehem Steel Company.

BRIDGE WITH A VIEW

This progress photograph shows the twin spans, constructed on T-type granite-faced piers. Upstream pier faces are wedge-shaped to divert ice and debris.

This is the Delaware Water Gap Bridge, crossing the upper Delaware River between Pennsylvania and New Jersey. Officially opened for traffic in December, 1953, shortly after the above picture was taken, the bridge gives motorists a magnificent view of the famous Delaware Water Gap.

But even more pleasing to travelers is the fact that the new span, with its access highways, eliminates a serious bottleneck and speeds traffic to and from the Pocono Mountain resort area.

Constructed at a total cost of $8,276,000, the four-lane toll bridge crosses the Delaware at a northwest-southeast angle, 28 degrees to the axis of the river.

Actually, the structure consists of two spans, of simple plate-girder and continuous-girder construction, erected side by side on 31 T-type reinforced-concrete piers. It is just short of one-half mile in length, and contains 5623 tons of structural steel, fabricated and erected by Bethlehem.

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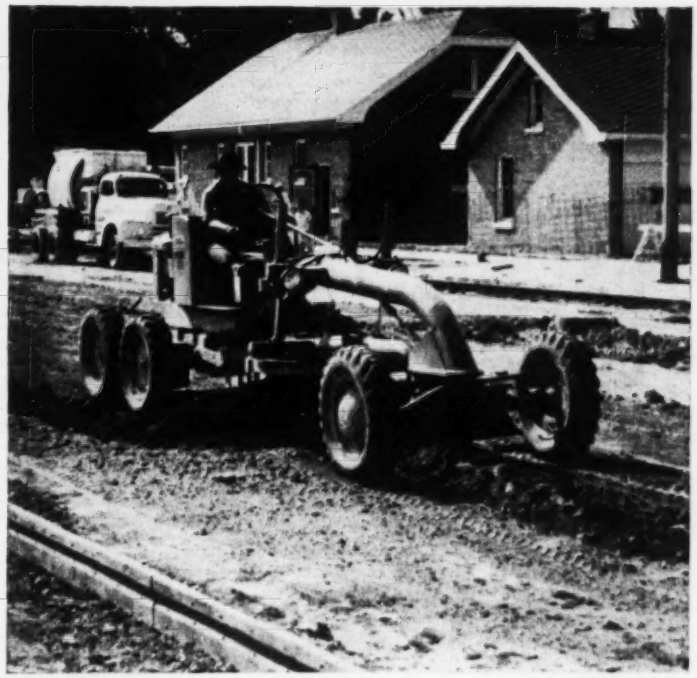
THOUSANDS OF ALLIS-CHALMERS MODEL D MOTOR GRADERS NOW IN USE



FINISHES BETWEEN FORMS, cleans up, loads trucks, backfills, landscapes . . . at low cost.

Five Years in the Field Prove Big-Grader Performance at One-Third the Cost

From its introduction in 1949, the Allis-Chalmers Model D established itself as a real pacemaker in the motor grader field. It was the first low-cost machine to offer tandem drive, single member tubular frame and the famous ROLL-AWAY moldboard. The "D" has proved again and again that it does outstanding work on both construction and maintenance.

Several easily mounted attachments make it invaluable all year 'round: hydraulically controlled, rear-end loader; shoulder maintainer that is interchangeable with loader bucket; hydraulically controlled scarifier; both blade and V-type snowplows.

Allis-Chalmers has now added even more to the Model D's workability. It offers a new 50 brake horsepower, "POWER-CRATER" engine; leaning front wheels** and power circle turn**. Yet the Model D's original cost is still only one-third that of a large grader, and operating, service and replacement part costs are proportionately low.

We invite you to talk with your nearby Allis-Chalmers dealer . . . compare values . . . and then ask for a demonstration.

**Optional equipment ROLL-AWAY and POWER-CRATER are Allis-Chalmers trademarks.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

LETTERS from contractors—

Sirs:

We purchased our first Model D in July, 1952. We are called on to do almost every kind of job known to the industry from paving small private driveways and parking areas to the larger street and road jobs. We also do a lot of paving inside buildings such as garages and warehouses. We find the Model D will deliver the goods in close places and on small jobs with a minimum amount of hand labor which is the difference between profit and loss on most small jobs.

The maneuverability, operator's vision, and mobility of the Model D make it a money-maker on any job, large or small. We find the Model D ideal for curb and gutter excavation, cutting sub grades, working intersections, laying down cold-mix materials, spreading base materials and finishing.

We purchased our second Model D in June, 1953, because our first machine had proved to be such a good investment. The Model D's do seventy percent of all our grader work, at our initial investment of about one-third that of the large machine. Our operating costs, fuel and repairs on the Model D's are less than one-third that of the large machine.

HUGH HANLEY
Norris-Hanley-Norris
General Contractors

Sirs:

On May 16, 1952, I took delivery on my Model D and in my opinion there is not a better machine built for small grading work. For spreading rock and dressing up shoulders, it is a dandy . . . you get up on the shoulder and dress it up without any break, and when you get through your work is done. No going back to repair rough places made by a heavier machine.

This grader hasn't been in the shop since it was purchased. I can grease it all over in five minutes. I belive it has made many times what it cost me.

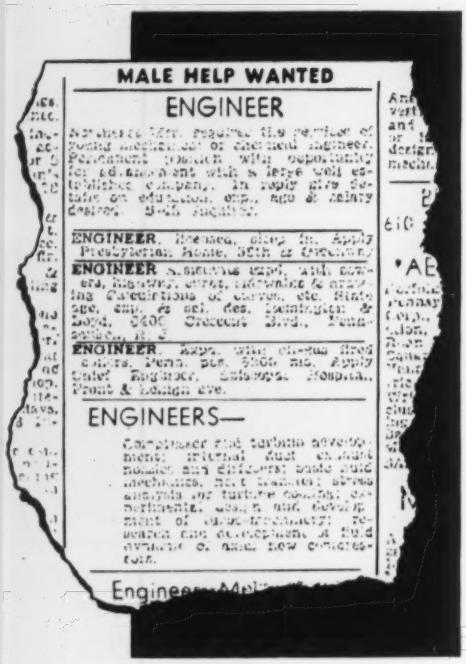
L. E. BUHLER
L. F. Buhler Construction Co.

Sirs:

We are very pleased with our Allis-Chalmers Model D Motor Grader. This machine is being used to rough grade and finish grade streets and lots on our 75 acre development. Our area is exceptionally rocky, but we feel we have done big grader work with this machine. We believe this is the toughest machine for its size we have seen.

The "D" is outstanding in its ease of operation. Our operator says he has excellent visibility at all times. It is economical to operate and has worked very satisfactorily.

I. J. MAY, *President*
Southwest Development Co.



No need to hire hard-to-get engineers for short term mapping

When you're planning a large scale but short term mapping project, today's shortage of engineering personnel can create manpower headaches.

You can avoid hiring temporary help or overloading your busy staff by calling AERO. Our experienced mapping crews fly swiftly over any area, delivering complete, precise photo coverage in a matter of days. For just a few cents an acre, you have a valuable planning guide—a bird's-eye view of your whole project. And from these photos, skilled AERO cartographers prepare topographic maps to the most exacting engineering requirements.

For planning cities, highways, railroads, pipe lines and power lines . . . for dam sites, housing projects or large scale industrial development, AERO provides needed maps for half the cost—or less, of ground surveys. Let us show you how we can take the headaches out of your next mapping project.

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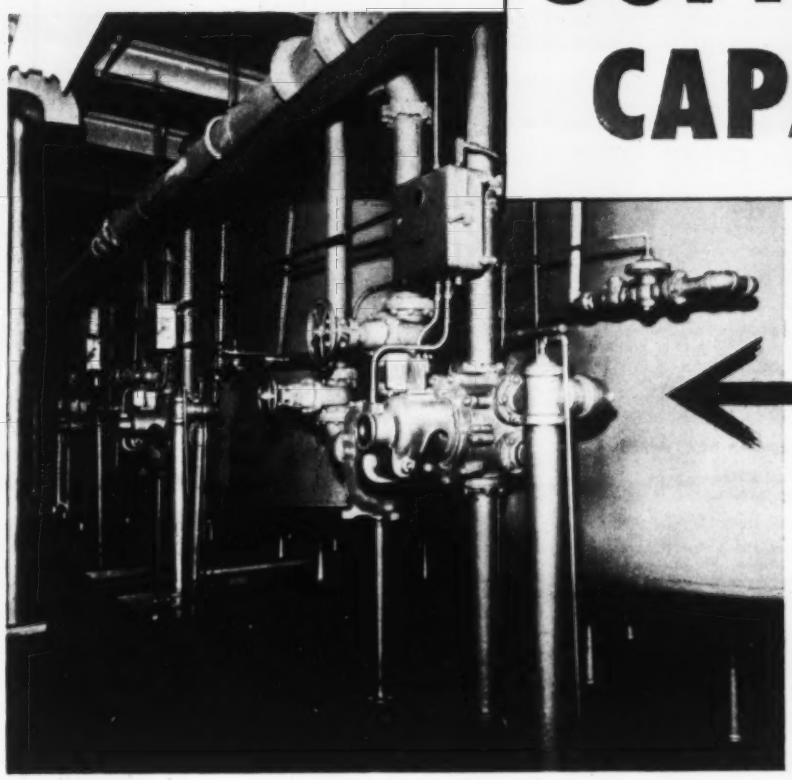
How the Town of Normal, Illinois

TRIPLED SOFTENING CAPACITY



...of the same softeners

...by changing to PERMUTIT Q

Replacing old-fashioned zeolite with the high-capacity ion exchange resin, Permutit Q, saves Normal over $7,000 a year!

Normal's three automatic softeners were installed back in 1946, before high-capacity Permutit Q was available. Each softener removed hardness from 83,000 gallons of water between regenerations for a daily delivery of 700,000 gallons of softened water.

Recently town officials called in Consulting Engineers, Farnsworth and Conley, of Bloomington, Illinois, who recommended replacing zeolite with modern, high-capacity Permutit Q.

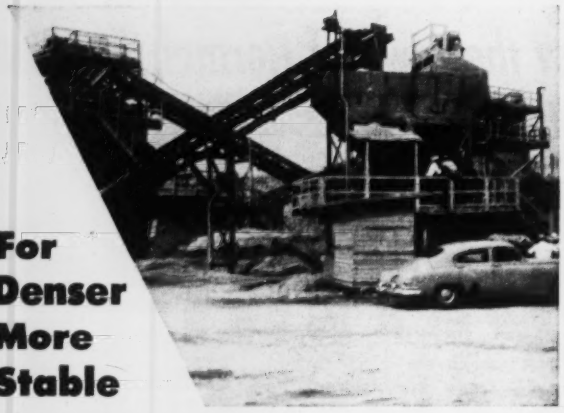
Look at the benefits gained from this change! The capacity of each softener is up from 83 to 270 thousand gallons between regenerations. Salt Consumption – down to about ¼ lb. per thousand grains of hardness removed. Flow Rate–up from 285 to 510 gpm. Regenerations – down from 3 times to once per day per softener.

A change to Permutit Q may effect similar economies for your city. We'll gladly send helpful data.

The Permutit Company, Dept. CV-7, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

PERMUTIT®



For Denser More Stable

GRADED AGGREGATE BASES

use

SOLVAY Calcium Chloride

The addition of SOLVAY Calcium Chloride to graded aggregate base courses will provide:

- **Quicker compaction at less cost!**
- **Substantial added protection against frost action!**

Base courses containing SOLVAY Calcium Chloride can be used as wearing courses without dusting or ravelling.

Send for FREE "Better Bases" Book

"Better Bases for Better Surfaces" contains authoritative information, data, photographs, charts, graphs, illustrations, mixture requirements and material specifications. No cost or obligation—write for your copy today!

Keep Unpaved Surfaces

DUSTLESS, COMPACTED SMOOTHER-RIDING

economically and *easily*—with Low-Cost, Clean, Odorless SOLVAY Calcium Chloride

SOLVAY Calcium Chloride is the inexpensive, efficient way to eliminate dust. It is easy to use on gravel, limestone, cinder, crushed stone and similar unpaved surfaces. Calcium Chloride can be quickly applied by regular maintenance personnel; no experience or expensive equipment is necessary.

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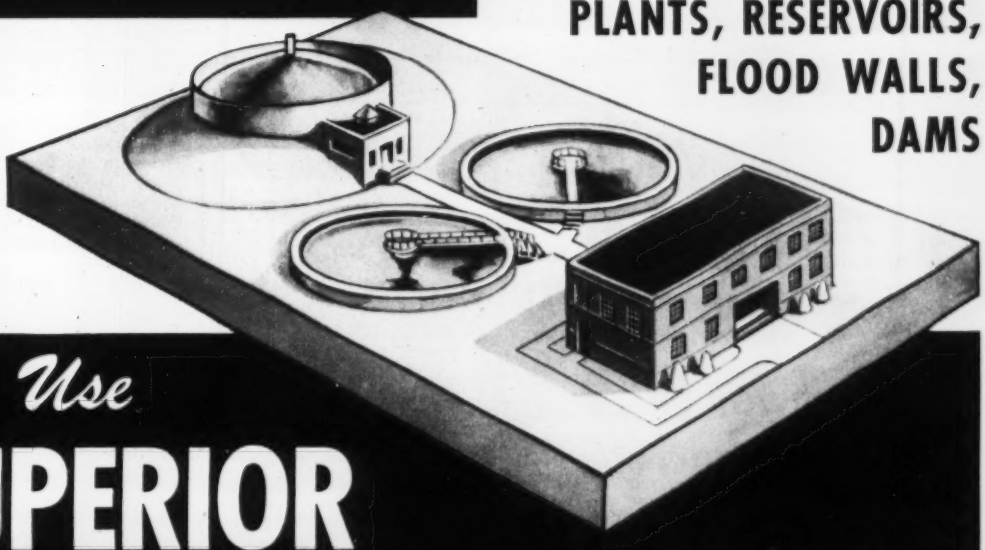
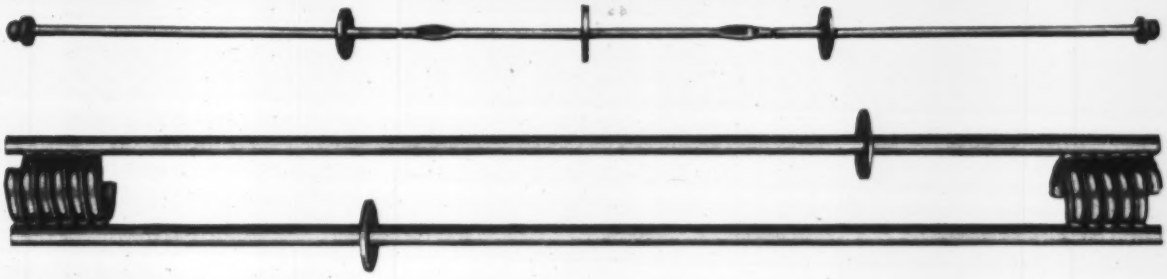
For Watertight Walls in..... **DISPOSAL and FILTRATION PLANTS, RESERVOIRS, FLOOD WALLS, DAMS**



Use

SUPERIOR

Water-Seal COIL OR SNAP TIES



The form tie used for water tight walls must, of course, be leak proof. The type of tie which is truly leak proof is determined by the anticipated height of head, and the resultant pressure.

Superior Snap Ties, and standard and Cone-fast Coil Ties, give satisfactory results for low heads, but for high heads, the use of Superior Water Seal Ties provide a real and justifiable insurance against leakage.

Superior Water Seal Snap Ties, and Coil Ties, both standard and Cone-fast, are provided with a water stop in the form of a securely fixed washer near the middle of the tie as illustrated. This washer effectively breaks the continuity of the rods, preventing seepage along the tie.

On any forming job, use SUPERIOR Concrete Accessories and be assured of the best in material, design and workmanship . . . plus the services of our experienced engineers who are always available to help plan your form work.

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Voids save concrete and steel!

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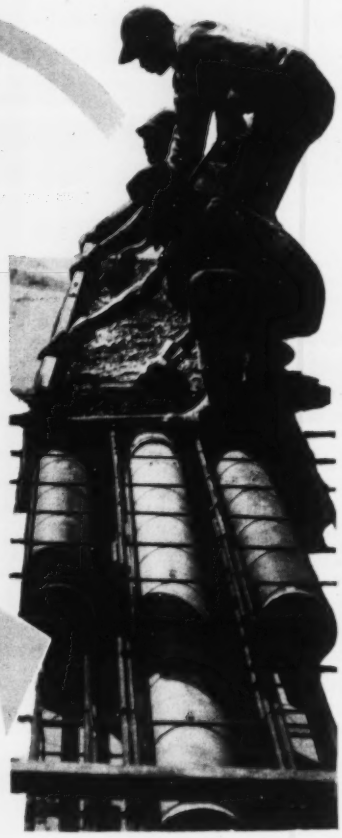
for voids in concrete construction



Pouring concrete slab —Paper mill.

Specifically developed for use in concrete bridge deck, wall, floor and roof slabs, low cost SONOVOID Fibre Tubes eliminate the dead weight without impairing structural strength . . . and save concrete and reinforcing steel.

SONOVOID Fibre Tubes displace the low-working concrete at the neutral axis.

Makes prestressed or poststressed precast units handle easier and cost less.

SONOVOIDS are supplied in specified lengths or sawed to your requirements on the job. Sizes 2″ to 36.9″ O.D. up to 50′ long.

For complete technical data and prices, write

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GARAGOUS, N. — BRANTFORD, ONT. — AKRON, OHIO

SONOCO

DECEASED

Abraham Martin Aloff (A.M. '35), age 46, for the past 23 years civil service examiner for the Massachusetts Division of Civil Service, Boston, died on April 28. A veteran of World War II, Mr. Aloff served in the Corps of Engineers for four years. He received the bachelor of arts and master of science degrees from Harvard University in 1929 and 1930, and in 1951 graduated from the Boston University Law School.

Bjarne Bergsland Anderson (A.M. '22), age 63, since 1947 senior contracting manager for the American Bridge Division of the U.S. Steel Corp., in the New York area, died in Brooklyn on May 7. Except for a two-year period of military service in World War I, Mr. Anderson had been with American Bridge since 1916. After ten years at the Ambridge (Pa.) plant, he was assigned to the New York area, where he advanced to the post of contracting engineer and manager (1930–1947). Among the contracts Mr. Anderson obtained for the company were those for the steel work on such projects as the United Nations' buildings in New York, the Tappan Zee bridge, the New York World's Fair, and several large metropolitan housing developments. He was an alumnus of Brooklyn Polytechnic Institute.

Krishnaji Govind Bhate (A.M. '48), age 46, executive engineer on design for the Public Works Department of the Government of Bombay, Poona, India, died on March 25, 1953. Continuously connected with the department since his graduation from the University of Bombay in 1930, Mr. Bhate was engaged in the maintenance of highway and irrigation projects, and the design of reinforced concrete bridges, dams and hydraulic structures.

Richard Meyer Brown, Jr. (J.M. '51), age 25, ensign, U.S. Navy, was killed in an aircraft accident while on maneuvers near Fallon, Nev., on April 8. Following his graduation as a civil engineer from the University of Washington in 1951, Mr. Brown was employed as a tool design engineer by the Boeing Airplane Co., Seattle. He entered the service early in 1952.

Dwight Arlington Davis (A.M. '28), age 67, design engineer for Commonwealth Associates, Inc., of Jackson, Mich., died in that city on April 21. Since 1923 Mr. Davis had held positions with the Commonwealth and Southern Corp., and the Fargo Engineers Co., both of Jackson; Giffels and Vallet, Inc., Detroit; and the Michigan State Highway Department at Nashville and Wolverine. He was a graduate of the University of Michigan, class of 1911.

Albert John Dates (M. '48), age 64, a member of the Ann Arbor, Mich., engine-

ering firm, Jensen, Bowen & Farrell, died on March 30. Except for three years with Giffels & Vallet, Mr. Dates had been with the company continuously since 1932, advancing from senior engineer and head of public utility appraisal work to membership in the firm. Earlier he was connected with several Detroit firms. He was a graduate of the University of Toronto, class of 1913.

Michael Clarence Drapack (J. M. '52), age 24, lieutenant, U. S. Air Force, died in an automobile accident in Puerto Rico, where he was stationed, on February 23. Immediately after graduation from the University of Detroit in 1952, Lieutenant Drapack enlisted in the Air Force. He served at the Kessler Air Force Base for eighteen months.

John Wilson Dougherty (M. '51), age 41, chief supervising engineer in the Los Angeles office of the Bechtel Corp., died in Pasadena, Calif., on May 1. Mr. Dougherty joined the Bechtel Corp. in 1946 upon his release from wartime service in the Corps of Engineers. He served as executive officer during the Third Army campaigns in Normandy and France, rising from the rank of lieutenant to lieutenant colonel and receiving the Bronze Star. Earlier Mr. Dougherty was in U. S. Engineer offices in Los Angeles and Portland, Oreg., and taught hydraulics at Carnegie Institute of Technology and the University of Iowa. He was a graduate of Oregon State College, with a graduate degree from Carnegie.

John Dougherty

Roy Cordis Hardman (M. '18), age 73, died on April 20 in Los Angeles, where he had been living since his retirement in 1941. Mr. Hardman had a long career in highway, concrete and water supply design and construction for the government of the Philippines (1904–1907), the Panama Canal (1916–1925), El Salvador (1925–1928), and Costa Rica (1928–1929). From 1934 to 1943 he was PWA representative to the Philippines and the Virgin Islands. Mr. Hardman was a graduate of the University of Iowa, and author of many technical publications.

James Francis Loughran (A.M.'11), age 70, chairman of the New York State Bridge Authority, and village engineer for Saugerties, N.Y., died in Kingston, N.Y., on May 10. Mr. Loughran started his career as a surveyor in the office of the New York State Geologists Survey in Albany and Schoharie counties. In 1909 he became Ulster County superintendent of highways, a post he resigned last year. He was appointed to the Bridge Authority in 1945 and became chairman four years

(*Continued on page 96*)

Cut concrete column costs!

Pouring concrete —Pierce and Phelps Co. bldg. Phila., Pa.— Robert E. Lamb Co., contractors Photo by E. Troiani

DENFORM reusable capital form designed for use with SONOTUBES. Write for details.

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SONOTUBE Fibre Forms for concrete columns save construction time, labor and money!

Save *time* because they are quickly erected and require minimum bracing.

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Widely used by contractors and approved by engineers and architects everywhere.

Available in 31 sizes, from 1″ to 36″ I.D. up to 50′ long.

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Construction Products Division

HARTSVILLE, S. C. — MAIN PLANT

ANOTHER PROBLEM SOLVED BY SPENCER, WHITE & PRENTIS

Underpinning piles act as soldier beams

No release of load while wedging is being done

Project: Bell Telephone Laboratories Addition, Murray Hill, N. J.

General contractor: Mahony-Troast Construction Co., Clifton, N. J.

Architects: Voorhees, Walker, Foley & Smith, New York

Easy access speeds progress, cuts costs

PRETEST UNDERPINNING PREVENTS SETTLEMENT IN TUNNEL JOB

To construct a bus terminal, a tunnel was needed beneath this Bell Telephone Laboratory housing delicate instruments. Routine methods offered no answer. The architects called upon Spencer, White & Prentis, who solved the problem speedily and economically with Pretest Underpinning — a method originated by this firm.

The essential difference between Pretest Underpinning and other methods is that in Pretest Underpinning the transfer of the load from the foundation to the underpinning cylinder is done with the full test load maintained on the cylinder by the hydraulic jacks. Even during wedging, the full load is maintained. This method of transferring the load is the Pretest feature which eliminates the damaging settlement inherent in other methods.

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Deceased

(*Continued from page 95*)

later. He attended Rensselaer Polytechnic Institute and Columbia University.

Joseph Patrick Martin (A.M. '13), age 77, retired engineer of Salt Lake City, Utah, died on March 16. He was an alumnus of Lehigh University, class of 1900. Mr. Martin was continuously connected with the U. S. Forest Service at Ogden, Utah, from 1907 to 1938, advancing from construction to regional engineer. From 1938 until his retirement in 1946, he was with the Federal Power Commission, Washington, D.C., and the Little River Station, Miami, Fla.

Neal Albert Melick (M. '20), age 73, for several years project manager of McCloskey & Co., of Tampa, Fla., died on November 25, 1953. A graduate of Ohio State University, Mr. Melick worked for the Pennsylvania, New York Central, and Virginian railroads. In government service for a number of years, he held the posts of construction supervising engineer of public buildings, in the Supervising Architect's Office, Washington, D.C. (1910–1918, 1921–1934) and supervising engineer for the Federal Works Agency (1934–1942).

Vincent Laddie Millen (A.M. '41), age 41, structural engineer with Wyatt C. Hedrick, Fort Worth, Tex., died in that city on January 24. A 1935 graduate of the Georgia Institute of Technology, Mr. Millen was connected with the Jones & Laughlin Steel Corp., Pittsburgh, Pa., and Robert & Co., Atlanta, Ga. He then entered the Army for a five-year period, and in recent years practiced structural engineering in Green Bay, Wis., and with the Leo A. Daly Co., at Omaha, Nebr.

George Lewis Mylchreest (M. '31), age 69, for 30 years a member of the consulting engineering and architectural firm, Mylchreest & Reynolds, of Hartford, Conn., died there on April 25. His firm was responsible for the design of many of the city's industrial buildings. Earlier Mr. Mylchreest was with Buck & Sheldon, of Hartford, for 14 years, advancing from draftsman to member of the firm. He was an alumnus of Wesleyan University and the Massashusetts Institute of Technology.

Benson Bulkeley Priest (M. '16), age 77, former civil engineer with the American Bridge Co., in New York, died on May 6, at Williamsport, Pa., where he had been residing since his retirement in 1945. Mr. Priest, who had been with American Bridge for 44 years, was an authority in the design of steel buildings. He graduated from the Massachusetts Institute of Technology in 1898.

Walter Harold Root (M. '43), age 65, deputy chief engineer of the Iowa State Highway Commission, Ames, Iowa, and since January chairman of the National Highway Research Board, Washington, D.C., died at Ames, on April 27. Mr.

(*Continued on page 102*)

PHOENIX "ROUNDUP"

IH Stages the Greatest Earthmoving Show on Earth

New, complete INTERNATIONAL line introduced to world-wide distributor organization at Industrial Power "Roundup"

Promptly at 9:00 A.M. recently, a barrage of aerial bombs exploded over the desert south of Phoenix, Arizona.

The explosions signaled the start of the greatest show ever presented by an individual heavy equipment manufacturer—the introduction of the new INTERNATIONAL Industrial Power line.

The International Harvester Industrial Power "Roundup" was a three-day presentation of more than 80 pieces of heavy earthmoving equipment, materials handling machinery, diesel and carbureted engines and power units in the new, expanded INTERNATIONAL Industrial Power line.

But the 612 INTERNATIONAL Industrial Power Distributors, their bankers and associates from the United States and 24 foreign countries got more than a first look at the big parade of IH Industrial Power.

They saw the answer of IH to the present and future requirements of one of the world's biggest industries—construction.

As an IH official told them, "There's no foreseeable end to the present heavy construction boom. We are determined to anticipate the demand and to build machinery necessary for the continual economic development of America and the free world."

HIGH ON A HILLTOP, Bill Hall and his new, 155 drawbar horsepower INTERNATIONAL TD-24 crawler tractor, command a view of IH's 4200-acre Phoenix Proving Grounds, site of the recent INTERNATIONAL Industrial Power "Roundup."

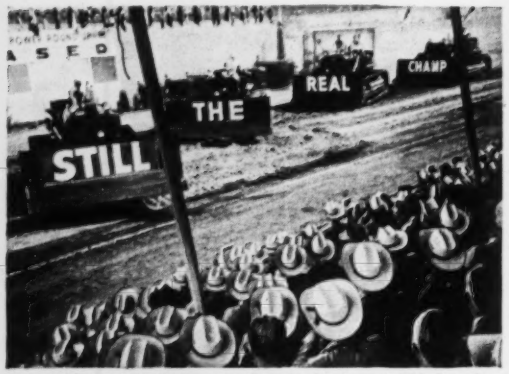
INTERNATIONAL HARVESTER

INTERNATIONAL

MAKES EVERY LOAD A PAYLOAD

On the pages following, you will see the whole story, in pictures, of this great demonstration event. Just turn the page to start your own visit to the INTERNATIONAL Industrial Power "Roundup."

PHOENIX "ROUNDUP"



"ROUNDUP" AUDIENCE gets first look at new 155 drawbar horsepower INTERNATIONAL TD-24, world's most powerful crawler. The TD-24, with matched hydraulic or cable-controlled blade, handles the toughest "pioneering" jobs.

PROUDLY PROCLAIMING THEIR SUPERIORITY in their horsepower field, a trio of INTERNATIONAL TD-18A crawler tractors park in front of the "Roundup" grandstand for audience inspection and approval.

LARGEST OF THE SPECIAL PURPOSE MACHINERY displayed at the "Roundup" was this INTERNATIONAL TD-24 crawler with matched Superior sideboom. TD-24 boom tractor will lift up to 45 tons.

TWO NEW PRODUCTS FOR ACCELERATED EARTHMOVING pass the "Roundup" grandstand. Rubber-tired earthmover is the INTERNATIONAL 2T-75, with 18-yard heaped capacity and a top speed of nearly

"Every Load

At the Phoenix "Roundup", INTERNATIONAL showed its distributors a lineup of "phased" equipment specifically designed to meet the requirements of the construction industry.

Included in the long list of equipment were new crawler tractors, ranging in size from 20-ton mountain-moving giants to basement excavators; high-speed units that haul half a railroad car of earth each load;

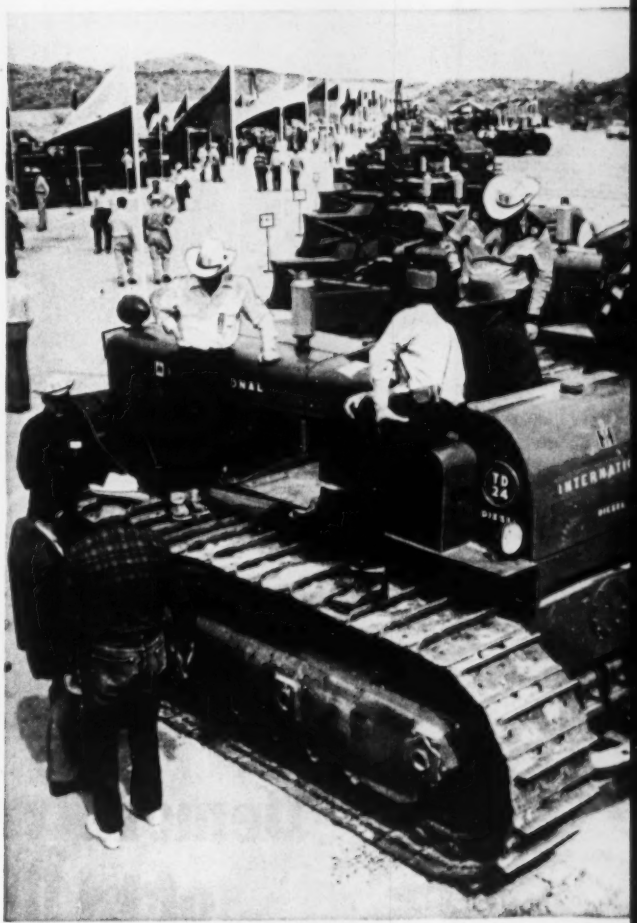
READY TO TEST A NEW INTERNATIONAL 2T-75 is IH vice-president Harald T. Reishus. Instructions for the run are given by C. E. Jones, assistant sales manager. Holding stop watch at the right is sales manager I. P. Payne. Cactus in picture is famed Arizona saguaro.

25 mph. Pusher is the new 200 horsepower INTERNATIONAL TD-24 torque converter crawler tractor. These are the largest units in the line, which now includes more than 80 pieces of equipment.

a Payload"

a torque-converter tractor that operates as smoothly as chauffeur-driven limousine; equipment equally adept at stockpiling bags of concrete or crates of china; and power units capable of lighting a medium-size city.

By putting the proper piece of equipment on each phase of the earthmoving job, INTERNATIONAL Distributors can show their customers how production profits rise while operating costs fall.



THE NEW INTERNATIONAL TD-24 TORQUE CONVERTER gets a thorough going over by a group of distributors. With same dimensions as conventional TD-24, all equipment that fits the conventional TD-24 fits the torque converter model.

FAST-STEPPING GIANTS PERFORM FOR CROWD. Boss of the heavy earthmoving jobs is this largest crawler tractor-scraper combination manufactured today. Crawlers are the new 155 drawbar horsepower INTERNATIONAL TD-24s. Partner in this big earthmoving act is the new INTERNATIONAL B-250 a 27½-yard heaped capacity push-loaded scraper.

Turn the page for more "Roundup" news

CHARGE OF THE HEAVY BRIGADE. Part of the equipment used in the "Roundup" leaves the assembly "corral" for demonstration sites on IH's Phoenix Proving Grounds.

Demonstration—Cornerstone of IH Distributor Sales

In only one respect did "Demonstration Day" differ from any other day at the IH Phoenix Proving Grounds: grandstands were erected at each of 10 demonstration sites where distributors could see equipment in action.

Other than that, everything was the same. All equipment went through standard demonstrations and test runs.

Phoenix is only the first "torture" session for IH earthmoving equipment. Additional tests and demonstrations are conducted, year round, at other IH proving grounds and on actual jobsites. A lengthy and expensive process, but one that assures contractors of this fact: INTERNATIONAL Industrial Power means more power, more speed, greater durability and less operating expense on any earthmoving or heavy construction job.

Your INTERNATIONAL Industrial Power Distributor will gladly arrange a demonstration of the model in the new, complete INTERNATIONAL line "sized" for your job. Let him prove that putting INTERNATIONAL Industrial Power equipment on the job puts more profit in your pocket.

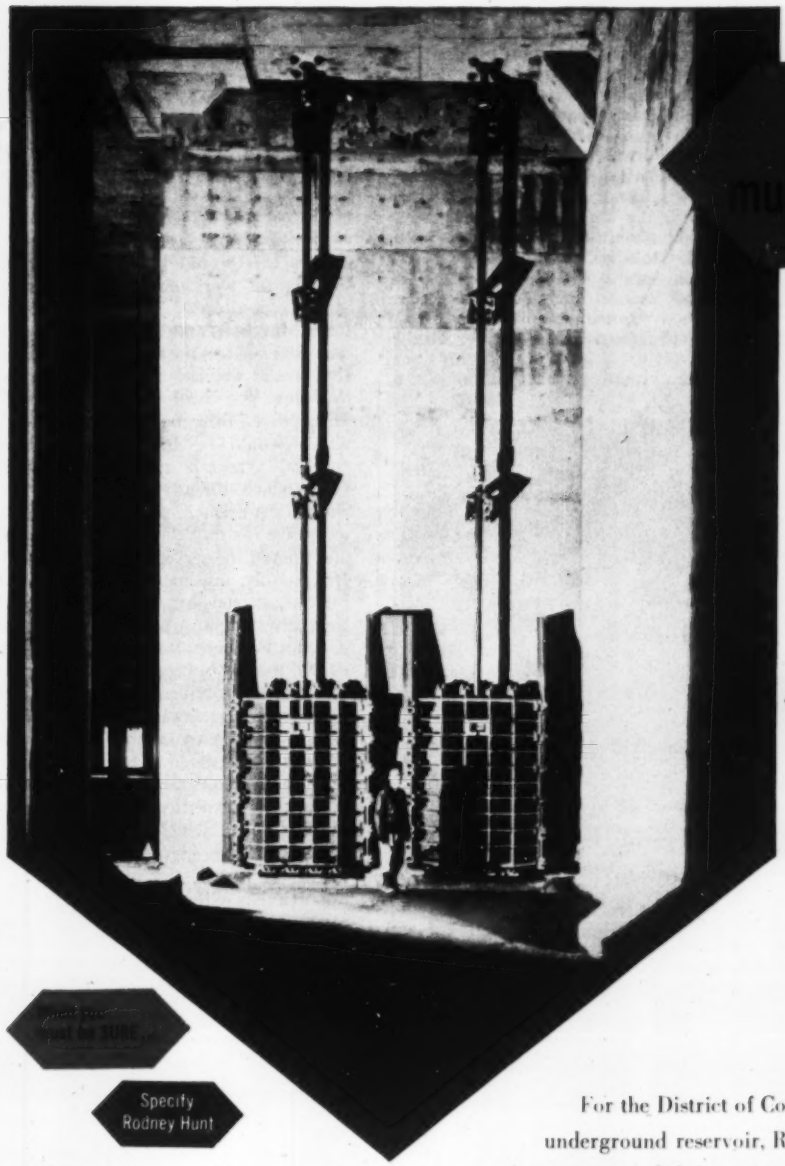
INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

INTERNATIONAL HARVESTER

INTERNATIONA

MAKES EVERY LOAD A PAYLOAD

TAKING ADVANTAGE OF A COFFEE BREAK are (l to r) Governor Howard Pyle of Arizona, "Roundup" host, Harald T. Reishus, vice-president, International Harvester and John L. McCaffrey, president.



For the District of Columbia's vast underground reservoir, Rodney Hunt cast iron bronze-mounted sluice gates were installed.

Two of the eleven Rodney Hunt gates are shown; the others are as large as 8′ x 8′ clear-opening. All have heavy-duty wedges on all sides, double-bolted top and bottom, to withstand more than 50 feet of unseating pressure.

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Deceased

(*Continued from page 96*)

Root had been with the Commission since 1912, serving as maintenance engineer for 35 years and as assistant chief since last year. He was a civil engineering graduate of Iowa State College, class of 1911.

Speed Stephens Leonard (M. '49), age 60, construction engineer for the U.S. Bureau of Reclamation at Friant, Calif., died in Fresno, on October 9, 1953. Mr. Leonard was with the Bureau for more than seventeen years, and had worked on Shasta and Friant dams, the Friant-Kern Canal, and the Madera Irrigation District. Previously he was with both the city and county of Los Angeles, the Los Angeles County Flood Control District, and the Metropolitan District of Southern California. He was an alumnus of Montana State College.

Dana Melvin Wood (M. '21), age 70, who retired on March 31 as chief of the Power Studies Branch of the Tennessee Valley Authority, Knoxville, died at Wellesley Hills, Mass., on May 10. He had been with the TVA for 20 years. Previously he was an assistant engineer with the U.S. Geological Survey for four years, and a hydraulic engineer for Stone & Webster, Boston, Mass., for 22 years. Mr. Wood was an alumnus of the Massachusetts Institute of Technology, class of 1906.

"DIATOMACEOUS FILTRATION MERITS SERIOUS CONSIDERATION"

In the February 1954 issue of the Journal of American Water Works Association, Mr. J. K. Fraser (Civ. Engr., Barker & Wheeler, Engrs., Albany, N. Y.) states "Where intermittent filtration must be provided and where the water is of a character that lends itself to filtration by diatomaceous earth, such a process MERITS SERIOUS CONSIDERATION."

The photo shows a diatomaceous earth filtration system installed at Tupper Lake, N. Y. In his article, Mr. Fraser tells why this 1.75 MGD system was selected in preference to a sand filter system. He also speaks about the flexibility of the system — about its quick starting characteristics — about its ease of backwashing and economy of operation.

We will be happy to send you a copy of Mr. Fraser's article "Diatomaceous-Earth Filtration in New York State" — also Bulletin 1800 describing Proportioneers Purecel Diatomite Filtration Systems. Proportioneers, Inc., 360 Harris Ave., Providence 1, R. I. Technical service representatives in principal cities of the United States, Canada, Mexico and foreign countries.

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It can happen to you . . .

(This article begins on page 51)

(*Continued from page 51*)

it a second thought. Reflect on the past tactics employed by union bosses.

"Approved" consultants

Another approach may be used. Contractors would be warned against bidding for work designed by a non-union consultant. That would be a faster method and probably simpler. There are second-rate consulting firms that would welcome the opportunity to leap onto the band-wagon and become an approved firm eligible to design work which would be built without labor trouble. There is at least one firm in Ohio which already has boarded the wagon. A member of that firm came to our office the day the strike was settled and offered the services of his company. He proudly informed us that he was fully approved by the IUOE. Until then my company had had a high regard for engineers but I assure you this behavior sadly lowered that esteem.

Let us not sacrifice the respect gained by our predecessors in return for a false security and easy money. Who can hope to be respected or to prosper in the long run by pursuing a course of compromise or expediency? Such is the foundation on which the labor unions are building an engineering force. We must not permit the weak-sisters and opportunists within the ranks of the profession to subvert the status it has achieved.

If a collective bargaining group becomes a necessity, then let us organize one of our own based on professional fundamentals. In the Ohio situation I believe a professional collective bargaining group could provide a solution. That would be in accord with my understanding of ASCE policy. After being formed and recognized by the National Labor Relations Board, a professional engineer group would be able to represent its members, without interference by IUOE, in relationships with their several employers. Such a group, when formed, could decide by majority vote whether it wished to negotiate collectively or not. It would be free to act as the majority of the group chose. However much we may dislike the idea of collective action, such a course is better than standing by idly until we find ourselves under the control of trade union leaders whose objectives are power and self-aggrandizement.

(This article was originally presented by Mr. McCoy as a paper at ASCE's Atlantic City Convention, before the general session presided over by G. Brooks Earnest, chairman of the Society's Committee on Conditions of Practice.)

News of Engineers

(*Continued from page 29*)

Charles P. Richardson, of Chicago, is retiring on July 1 as assistant deputy for the Railroad Office of Civil Defense, State of Illinois. Engaged in railroad engineering for 47 years, Mr. Richardson started his career with the Missouri Pacific lines in 1907, and was with the Rock Island lines from 1921 to 1951, when he retired from active railroad work to accept the civil defense appointment.

John A. Shaw, former chief engineer for Standard Vacuum Oil Co., at Hongkong, and now supervising engineer for Chaffey College, Ontario, Calif., has been elected a city councilman for Claremont, Calif. He has served for eight years on the Planning Commission.

John R. Clifton, lieutenant colonel, Corps of Engineers, has been assigned to the 199th Combat Battalion at Fort Leonard, Mo., and will assume his new post on July 25. Colonel Clifton has just completed a two-year tour of duty in Greenland and the United States for the Northeast District of the Corps.

Robert E. Hickson, head engineer and chief of engineering for the North Pacific Division of the Corps of Engineers at Portland, Oreg., retired on April 30 after 46 years of service. Mr. Hickson, who entered the Corps in 1909 after graduation from the University of Oregon, has participated in such projects as the Bonneville, McNary, Chief Joseph, and the Dalles dams.

W. H. Hudson, since 1950 chief engineer for the St. Louis Southwestern Railway Co., Tyler, Tex., has been named to the newly created position of assistant general manager, with headquarters at Tyler.

James W. Huston, a 30-year veteran of the Corps of Engineers, has received a Department of Interior appointment as director of the Alaska Public Works with headquarters in Juneau. Since 1947 Mr. Huston has been resident engineer in the Alaskan District in charge of military construction at the Elmendorf Air Force Base.

Arthur P. Clark, research associate for the American Iron and Steel Institute at the National Bureau of Standards, Washington, D.C., is this year's recipient of the Concrete Reinforcing Steel Institute Award. Mr. Clark received the award at the 30th annual meeting of C.R.S.I., at Boca Raton, Fla., for his contribution to the development of the A-305 type of reinforcing bar.

Lawrence B. Kuhns was awarded the Demers Medal by Rensselaer Polytechnic Institute, his alma mater, at ceremonies on June 12. The Demers Medal goes to an alumnus in recognition of outstanding service to the school and the alumni association. Mr. Kuhns is chief construction engineer for the Aluminum Company of America, with which he has been connected since 1924.

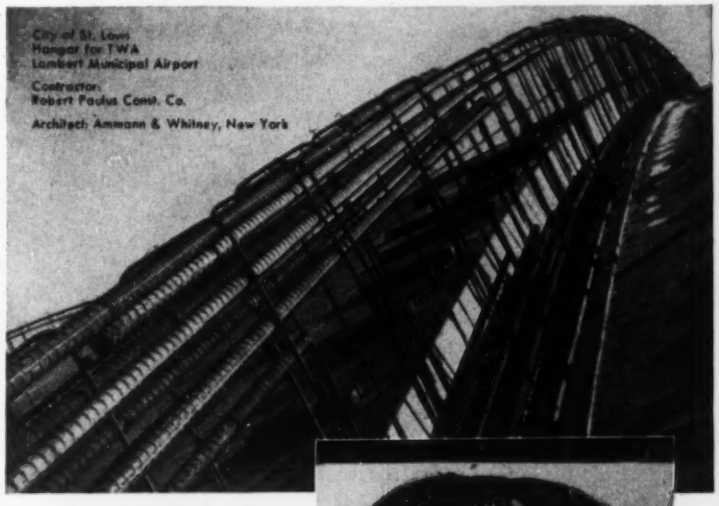
Finley B. Laverty, chief hydraulic engineer of the Los Angeles County Flood Control District, Los Angeles, Calif., has been appointed to the National Panel of Arbitrators of the American Arbitration Association. He will be available to groups submitting commercial disputes to arbitration.

Lenox R. Lohr, president of the Museum of Science & Industry, Chicago, Ill., was installed as president of the Society of American Military engineers at its 34th annual meeting at Annapolis, Md., May 13. Major Lohr was president of the ASCE Centennial of Engineering, Inc.

New in Education

A one-year graduate program in soil engineering will be inaugurated by the civil and sanitary engineering department of the Massachusetts Institute of Technology at the start of the 1954 fall term. The courses in this program are designed to give an understanding of the behavior of soil under conditions encountered in engineering. Applicants for the program should follow the procedure outlined in the Catalogue for graduate students. The Catalogue and application forms for admission to the Graduate School may be obtained from the

(*Continued on page 104*)



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New in Education

(*Continued from page 103*)

Director of Admissions, MIT, Cambridge 39, Mass.

Dedication of the $1,000,000 Gordon McKay Laboratory of Applied Science, on the Harvard University campus, at Cambridge, took place on June 16. The building, which was named in honor of Gordon McKay, the engineer, inventor, and Harvard benefactor, will house facilities for research in the fields of mechanical and electrical engineering and electronics.

A new laboratory for surface technology research has been opened in the Research Division of New York University's College of Engineering. Consolidation of research in one center will permit the use of new equipment that could not be housed in the former cramped quarters. The new laboratory facilities include a salt-fog chamber, paint mills, spray equipment, a steam-exposure chamber, a weather-o-meter, a profile analyzer, and various optical and electrical research instruments.

Non-ASCE Meetings

Fifth Conference on Coastal Engineering. The Conference on Coastal Engineering, one of the activities of the Council on Wave Research of the Engineering Foundation, will meet at Grenoble, France, September 8-11. Inquiries regarding the conference and requests for application forms should be directed to M. René Frappat, Secrétaire Général, Association Amis De L'Universite de Grenoble, Cinquieme Congrès de Coastal Engineering, Palais de L'Universite, Grenoble, France, or the Council on Wave Research, The Engineering Foundation, 245 Hesse Hall, University of California, Berkeley, Calif.

Pan American Highway Congress. Sixth congress at Caracas, Venezuela July 11-21. Details from the Pan-American Division of the American Road Builders Association, Washington, D.C.

UPADI. The third convention of the Pan American Federation of Engineering Societies (UPADI) will meet at Sao Paulo, August 2-12. Write to EJC, 29 West 39th St., New York, N.Y., for more detailed information.

World Power Conference. Sectional meeting will be held in Rio de Janeiro, July 25-August 10. Detailed information is available through EJC, 29 West 39th St., New York, N.Y.

Inter-American Association of Sanitary Engineering. Fourth conference will be held in Sao Paulo, Brazil, July 25-31. Details may be obtained from Engineers Joint Council, 29 West 39th St., New York 18, N.Y.

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Men Available

RESIDENT ENGINEER; J. M. ASCE; 28; married; B.S.C.E.; 4 years' experience central engineering department large industrial corporation. Management industrial projects at plants in United States and Canada. One year office experience estimating, specifications, design, preparing reports. Desires responsible position with consultant, contractor or central engineering for large organization. C-976.

CIVIL ENGINEER; J. M. ASCE; 23; married; B.S.C.E., 1952; Korean veteran; 2 years' diversified experience in surveying, design, construction and administrative engineering. Available August 1 upon release from U. S. Air Force. Desires permanent responsible position with construction or consulting firm. C-977.

CIVIL ENGINEER; J. M. ASCE; 27; married; B.S.C.E.; 2 years' experience as field engineer with major oil company; 1½ years' experience in estimating, planning and supervising construction. Desires active responsible work with advancement opportunity in contracting, consulting or sales. C-978.

CIVIL ENGINEER; J. M. ASCE; M.C.E.; Professional Engineer; 31; married. Desires permanent teaching position for the fall of 1954 in structural engineering and allied subjects. Eleven years of diversified responsible experience in structural and foundation engineering, including bridges, turnpikes, buildings, railroads, aircraft and teaching experience. C-979.

PROFESSOR, structural, hydraulic, fluid mechanics; M. ASCE; Ph.D.; 4 honorary societies; 25 years' teaching and practicing experience; now teaching. Desires relocation and some graduate courses. C-980.

CIVIL ENGINEER; J. M. ASCE; 23; single; B.S.C.E., 1952; 24 months' base engineering, minor construction and administration with USAF. Available in September upon release from USAF. Desires responsible work in construction, municipal engineering or highway field. Location preferred, Southwest. C-981.

CIVIL ENGINEER; J. M. ASCE; married; B.S.C.E.; 1 year experience as inspector on new construction and repairing projects; 2 years' service in USN Seabees with 1 year spent in material procurement. Desires work in South America or West Coast. Available mid-August. C-982.

Positions Available

ASSISTANT CHIEF STRUCTURAL DESIGNER, not over 40, on steel, concrete and timber, with particular emphasis on bridges and railroad work. Salary, $7,200 a year and up. Location, northern New Jersey. Y-8076.

INSTRUCTOR with B.S. or M.S. in civil engineering, to teach plane surveying, mechanics of materials. Opportunity for graduate study. Salary, $3,700–$4,000 for nine months. Location, Southwest. Y-9859.

SAFETY ENGINEER, under 40, civil graduate, with several years' experience on heavy construction work. Salary, $7,800 a year base, plus considerable overtime. Location, Iceland. F-9867.

RESIDENT ENGINEER, civil graduate, with experience in the supervision of rock tunnel for either owner or contractor. Two or three years work. Salary, $9,000–$9,600 a year. Location, southern New England. Y-9881.

CONSTRUCTION ENGINEERS. (*a*) Construction Engineers with experience in the construction of roads in both mountainous and flat terrain. (*b*) Construction Engineers experienced in all types of asphalt pavement. Ability to speak Spanish an asset. Location, Venezuela, S. A. F-9894.

ENGINEERS experienced in the following fields: airfield design, military camp design, highway bridges, grade crossing elimination, drainage, sanitation, soil mechanics, particularly in the field, concrete mixes, structures. A combination of these categories desirable. (*a*) Project Manager. (*b*) Designers. (*c*) Assistant Designers. (*d*) Draftsmen. Salaries open. Location, New York, N. Y. Y-9914.

CIVIL ENGINEERS. (*a*) Civil Engineer, graduate with some municipal experience, particularly on streets and sewers. Salary, $4,170–$5,670 a year. (*b*) Junior Civil Engineer, graduate, with about one year's experience in general civil engineering and some knowledge of streets and sewers. Salary, $3,500–$4,100 a year. Must be residents of northern New Jersey. Y-9932.

CIVIL ENGINEER experienced in supervision of triangulation surveys. State education, experience, salary desired. Location, Midwest. Y-9977.

CHIEF ENGINEER, mechanical, civil, electrical or chemical, with at least 5 years' experience in responsible supervisory position and preferably in process industries. Knowledge of pulp mill operations and pumps. Will direct engineering department comprised of 6 section heads and their subordinates, to support maintenance, design of new production machinery; some coordination of feeds and output for a paper manufacturer. Salary, $8,500–$10,000 a year. Employer will negotiate fee. Location, Alabama. Y-9987.

ENGINEERS. (*a*) Research Engineer for work on research problems relating to highway design, construction, operation and maintenance. Current projects related to bituminous pavements, non-destructive testing of concrete, highway traffic, snow removal, etc. Salary, $4,200–$6,000 a year. (*b*) Research Assistant for work on the project combined with part-time study making it possible to secure an M.S. degree in 2 years. Salary, $2,400 a year. Location, New England. W-4.

PROMOTIONAL ENGINEER, 30–40, civil engineering graduate, experience in paving and public works preferred, by long established promotional and educational organization, to be a representative in the central New York State area. Give resume of education, engineering experience and salary requirements. W-11.

SENIOR BUILDING CONSTRUCTION ENGINEER, licensed professional engineer, with construction experience. For a major building program which will involve construction of several new institutions and reconstruction of existing facilities. Salary, to start, $6,088 with 5 annual increments. Location, New York State. W-27.

INSTRUCTORS, graduate civil engineers, preferably with M.S. in civil engineering, also some special training in soil mechanics or sanitation. Salary, $3,550 plus bonus for 9 months; additional summer and evening classes available. Location, New York, N. Y. W-34.

ESTIMATOR, under 40, civil engineering training, with at least 5 years' estimating experience in building construction to prepare construction estimates, analyze costs. Salary, $6,000–$8,000 a year. Location, New York, N. Y. W-104.

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Large New York engineering and construction firm desires graduate civil engineer with at least 10 years experience in layout and design of hydroelectric developments. In addition, applicant should have broad experience in design of heavy foundations.

Work includes planning, supervision of design, writing of specifications, and requisitioning of material.

This is a staff position offering starting salary commensurate with experience.

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All replies to Box 233

Civil Engineering
33 West 39th Street
New York 18, N. Y.

HIGHWAY ENGINEER, 30–40, at least 10 years' experience including responsible charge in important positions for at least 3 years. Must be able to write clear reports and to make effective oral presentations to both technical and lay groups. Position requires some traveling. Headquarters in Eastern city. W-107.

HIGHWAY ENGINEER, civil engineering graduate with experience covering design and construction of roads, bridges, etc. Must have experience in Spanish speaking countries. Minimum contract 18 months; including transportation. Salary, $10,000–$12,000 a year. Location, Ecuador. F-114.

ESTIMATOR, 30–45, with at least 5 years' experience estimating fabricated steel and structural shapes. Will estimate structural steel fabrications. Salary, $6,000 a year. Employer will negotiate fee. Location, Chicago, Ill. C-1956.

FIELD ENGINEER, civil graduate, to 45, with at least 4 years' experience in design of structural or foundation work and/or construction work. Should be familiar with building and highway construction and timber structures. Will act as service engineer contacting members of trade associations and doing promotional type work. Salary, $6,000–$7,200 a year and expenses. Employer will pay fee. Considerable travel; car desired. Location, South. C-1957.

RESEARCH ENGINEER, graduate civil, with 4 to 5 years' experience, technical or in research laboratory, in field of cement concrete and concrete products. Will conduct technical investigations, write reports and handle technical correspondence. Should be capable of developing into competent consultant and research engineer on problems in the manufacture and use of concrete masonry units. Starting salary around and up to $6,000 a year. Some traveling. Location, Chicago, Ill. C-1965.

Positions Announced

Corps of Engineers. Construction inspectors are needed by the Corps of Engineers for mechanical, electrical, building and paving work in Pennsylvania, New Jersey, and Delaware, at salaries ranging from $3,410 to $4,205 a year. Vacancies currently exist at the McGuire and Dover Air Force bases and on various projects for the Anti-Aircraft Command in Pennsylvania and New Jersey. For further information contact the resident engineers at McGuire or Dover Air Force bases or the personnel officer in the District Office, 121 North Broad St., Philadelphia, Pa.

Town of Saugus. A vacancy now exists for the position of civil engineer with the Town of Saugus, Mass. Requirements for the job, which carries a salary ranging from $4,000 to $4,500 a year, are a civil engineering degree, and at least one year of municipal engineering experience. Statements of qualifications and salary requirements should be sent to Stanley B. Goldberg, Town Engineer, Saugus, Mass.

U. S. Civil Service Commission. Announcement of an examination to fill positions as Engineer (GS-9 at $5,060, and GS-11 at $5,940 a year) at Middletown Air Materiel Area, Olmsted Air Force Base, is made by the Civil Service Commission. Positions are available for civil, construction, electrical, industrial, mechanical, and sanitary engineers, with the proper education and general experience requirements. Detailed information and applications are available from the Executive Secretary, Board of U.S. Civil Service Examiners, Middletown Air Materiel Area, Olmsted Air Force Base, Middletown, Pa.

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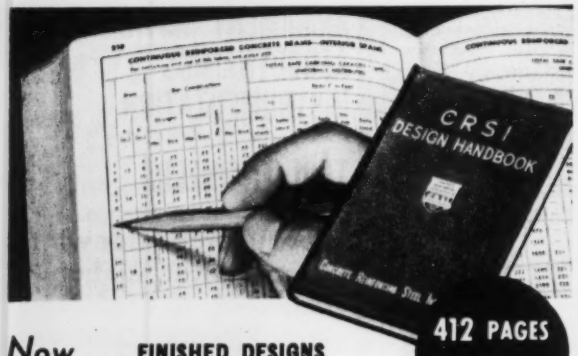

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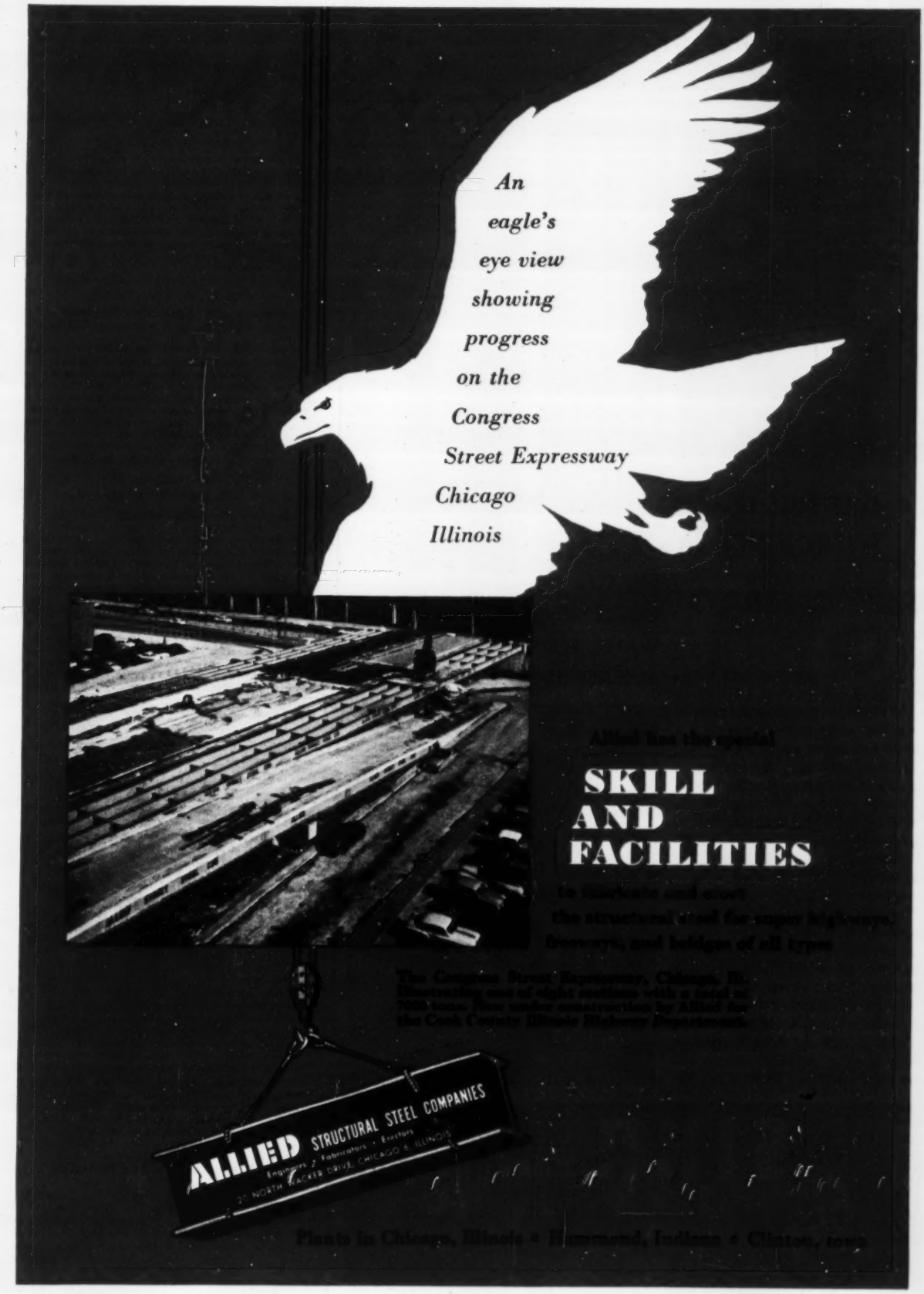
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RECENT BOOKS

Guidance Procedure for the New York Professional Engineers License

This manual, written by John D. Constance, to aid the engineer seeking a professional license in New York State, can also be used by applicants in other states, since New York procedure and requirements are based on the model law adopted to some extent by other states. Information is included on general procedures, the meaning of qualifying experience, application forms, methods of recording experience, the philosophy and purpose of the written examination, experience requirements for licensure without written examination, etc. Some of the material appeared previously in the journal "Power Engineering." (John D. Constance, 625 Hudson Terrace, Cliffside Park, N.J., 1954. 24 pp., $1.)

The Iron and Steel Industries of the South

This is an economic study of establishments concerned in the production of pig iron and also industries processing iron and steel or manufacturing a product for which these are a major raw material. The author, H. H. Chapman, covers the subject in the following major divisions: historical and general background; natural resources; iron and steel industries; the southern market; potentials of the industry. (University of Alabama Press, University, Alabama, 1953. 427 pp., $7.50.)

Manual of Precast Concrete Construction

Methods and procedures for concrete construction in general are shown by F. Thomas Collins, the author, with special emphasis on flat casting for walls and slabs, but with some material on thin shells. Construction scheduling and costs are treated briefly, and there is a separate chapter on sandwich type panel construction. (F. Thomas Collins, P.O. Box 208, San Gabriel, Calif., third edition, 1954. 102 pp., $25.)

Nouveaux Compléments D'Hydraulique Part 1

A collection of summaries of researches in the hydraulics field during the last two years is presented by L. Escande. Representative topics are as follows: handling of flood waters through high dams; studies of flow over dams under various conditions; water hammer analysis and surge chamber calculations with particular attention to graphical methods. (France, Ministère de l'Air, Publications Scientifiques et Techniques, No. 280, Paris, 1953. 232 pp., Ffrs. 1800.00.)

Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials

Special Technical Publication, No. 153 is intended to give the practical engineer a better knowledge of the field of ceramic technology. These fifteen papers discuss the characteristics and properties of ceramic coatings; describe their application for increasing the resistance of metal surfaces to abrasion, corrosion, and vibration; and deal, in particular, with their use on high-temperature components such as for jet engines. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1953. 122 pp., $2.50.)

Fundation und Konsolidation

With the previously issued Volume I, these books provide a comprehensive treatise on foundations and soil consolidation. Volume II covers in detail methods for the improvement of foundation soils (injection, mechanical compression, etc.), excavation for structures, floating footings, and deep footings. Volume III covers the theory and calculation of soil pressure, bottom pressure considerations, consolidation of earthworks, and the relation between soil mechanics and construction engineering. Curt F. Kollbrunner is the author. (Schweizer Druck-und Verlagshaus, Zürich 8, Switzerland. Volume II: 1948, 534 pp., DM 32.00. Volume III: 1952, 395 pp., DM 24.00.)

International Association for Bridge and Structural Engineering, Publications Volume 13

The nineteen papers included in this volume cover a considerable range: shell theory and analysis; arch analysis; properties of concrete; vibration phenomena; plasticity, theoretical and practical; light-alloy structures and fatigue strength; and various special applications of structural analysis. The papers are in English, French, or German, with titles and summaries in all three languages. (Verlag Leemann, Zürich, 1953. 366 pp., S. Fr. 40.00.)

Manual for Railway Engineering

This is the 1953 reprinting of the complete manual of the Construction and Maintenance Section of the AREA, containing all the current specifications and recommended practices of the Section except those on the design of frogs, switches, crossings, etc., which are published in another volume. The manual includes a glossary of terms, and data on roadways, ties, track, structures, records and accounts, economics of location and operation, and other subjects. Annual loose-leaf supplements are issued. (American Railway Engineering Association, 59 East Van Buren St., Chicago 5, Ill., 1953. Various pagings. $35.)

N.F.P.A. Handbook of Fire Protection

Essential information on methods of fire prevention and protection that have stood the test of time are compiled in compact form in the present edition of this handbook. New data has been added and obsolete material has been revised. There are new and revised tables of fire hazard properties

(*Continued on page 112*)

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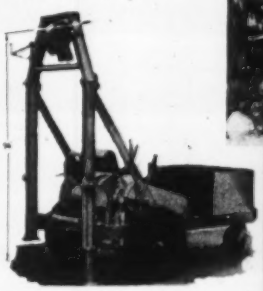

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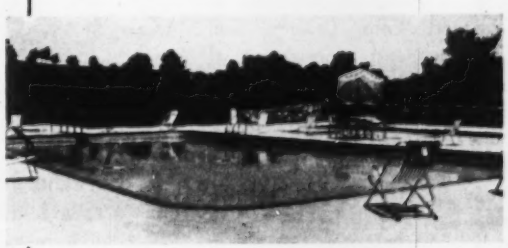

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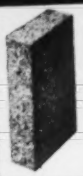

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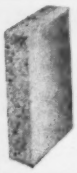

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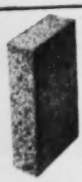

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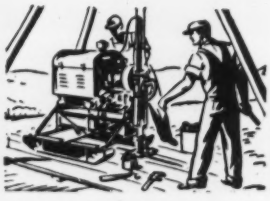

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Recent Books

(*Continued from page 110*)

of chemicals and solvents and other hazardous materials, new automatic spray sprinklers are now treated in detail, and material on combustible finish materials has been considerably revised. Robert S. Moulton is the editor. (National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass., eleventh edition, 1954. 1560 pp., $10.50.)

National Electrical Code, 1953
National Fire Codes, Volume V

The 1953 edition of the National Electrical Code replaces all previous editions and supplements. Basic minimum requirements for safety are defined for electric conductors and equipment used for light, heat, power, radio, signalling, and other purposes. There are chapters on general applications; on installations involving special occupancies, equipment, etc.; on installations of communication systems; and on construction specifications. A separate section gives electrical provisions of other NFPA standards. (National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass., 1953. 576 pp., $3.)

Resistance des Matériaux
Volume I: Théorie de l'Elasticité et des Structures Élastiques

A comprehensive text by Robert L'Hermite, on strength of materials which begins with a treatment of the theory of elasticity and certain major extensions; continues, with internal equilibrium under tension, bending, and torsion and the analysis of isostatic structures, girders, and girder systems; and devotes the last half of the book to a thorough treatment of plates, slabs and shells. Extensive chapter bibliographies are provided. (Dunod, Paris, 1954. 860 pp., Ffrs. 8400.)

Statics and Strength of Materials

While the coverage of this book is similar to that of existing texts, the arrangement of material differs in presenting statics and strength of materials as a unit. The primary emphasis is on principles, but throughout the text the author, Roland H. Trathen, uses illustrative problems to indicate methods of applying principles to the solution of engineering problems. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1954. 506 pp., $7.50.)

Fresh Water From the Ocean
For Cities, Industry, and Irrigation

In its investigation of the possibilities of drawing fresh water from the ocean on the grand scale of 1,000 million gallons per day, this book analyzes the basic matter and energy relationships with which any sea-water conversion method must deal. To determine their economic feasibility the various methods are assessed in terms of the major cost elements such as plant construction and power requirements. A method known as electrodialysis indicates economic promise. Prepared by Cecil B. Ellis and members of the staff of Nuclear Development Associates, Inc. (Ronald Press Co., 15 East 26th St., New York 10, N.Y., 1954. 217 pp., $5.)

The Dimensioning of Engineering Drawings

A practical text on the principles which govern the dimensioning of drawings for engineering components in their finished state when interchangeability is a requirement. The author, W. Abbott, is concerned with the distribution of tolerances previously decided upon, not with the determination of these tolerances. In addition to a thorough treatment of general principles, a considerable number of special conditions are dealt with. (Blackie & Son Ltd., Glasgow, 1953. 186 pp., 10s.6d.)

Hydraulique Technique

Beginning with a section on fundamental hydraulic principles, this text by Charles Jaeger has three subsequent major sections on steady flow, unsteady flow, and flow in underground strata. Par-

(*Continued on page 114*)

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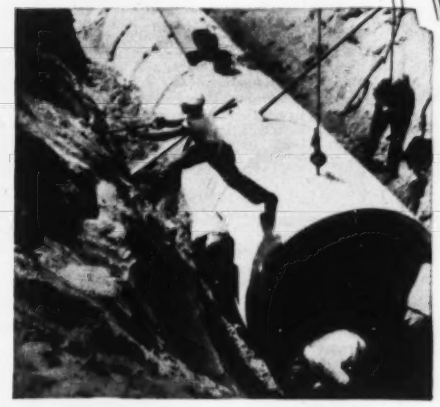

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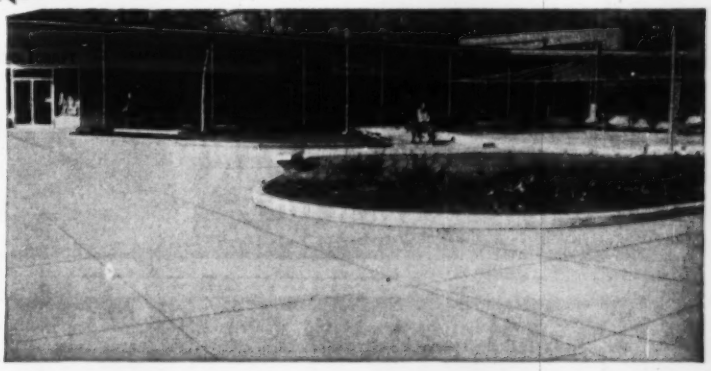

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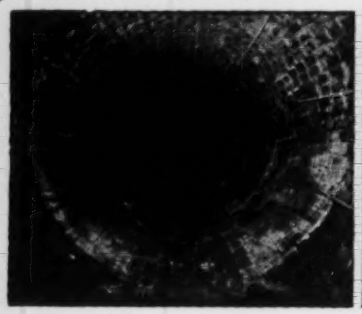

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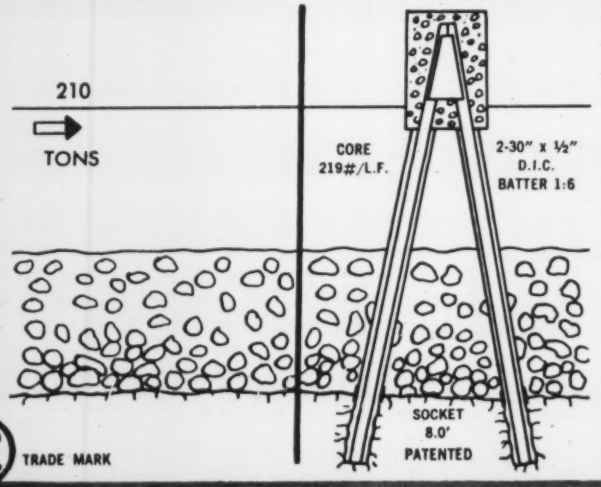

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Recent Books

(*Continued from page 112*)

ticular attention is paid to basic hydrodynamic equations, open-channel flow, surge tanks, and water hammer. An appendix discusses experimental values for hydraulic calculations dealing with the effect of bends and other physical conditions. (Dunod, Paris, 1954. 510 pp., Ffrs. 4900.)

An Introduction to the Theory of Seismology

This text begins with consideration of mathematical theories of elasticity, and of vibrations and waves. Five chapters on the application of wave theory in an elastic body follow, and the remainder of the book covers derivation of results special to seismography, principles of seismography, and the application of seismological data to earthquake phenomena. The text has been revised and a list of references, correlated with the sections of the text, has been added. K. E. Bullen is the author. (Cambridge University Press, 32 East 57th St., New York 22, N. Y., second edition. 1953. 296 pp., $6.50.)

Dwelling House Construction

Established methods of construction are dealt with by Albert G. H. Dietz, in this discussion of the assembly of a house from site selection to painting. Major changes in this edition are the addition of a chapter on panelized construction, and revision of the chapter on hardware. (D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N.Y., second edition, 1954. 396 pp., $6.75.)

Introduction to Nuclear Engineering

A survey of the nuclear-energy field for students, and for engineers who have completed the conventional courses. Following a brief review of nuclear physics, separate chapters discuss fission, the nuclear chain reactor, reactor theory, radiation shielding, materials of construction, and instrumentation and control. There are also chapters on the separation of stable isotopes, chemical separations and processing, and on special techniques such as handling radioactive materials and the design of carriers for shipping them. Richard Stephenson is the author. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y., 1954. 387 pp., $8.)

Manual of Photogrammetry

About eighty percent of the material in the present edition of this comprehensive manual of operating instructions and engineering fundamentals is new. Among the topics covered in chapters prepared by various authorities in the field are surveying, cameras and photography, stereoscopy, the interpretation of photographs, and methods of plotting and mapping. Rectification of aerial photographs is thoroughly treated. A list of photogrammetric terms and a bibliography are included. (American Society of Photogrammetry, Box 286, Benjamin Franklin Station, Washington, D.C., second edition, 1952. 876 pp., $12.50, members, $9.)

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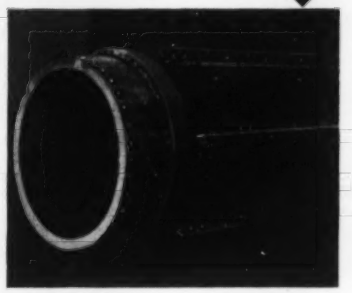

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HERNAN SANDOVAL-LORA, Ann Arbor, Mich.
LEOPOLDO SARRIA-HERRERA, Caracas, Venezuela.
CHARLES DRAGAN SUSMAN, New York, N.Y.
EDWIN JAMES WALLER, Stillwater, Okla.
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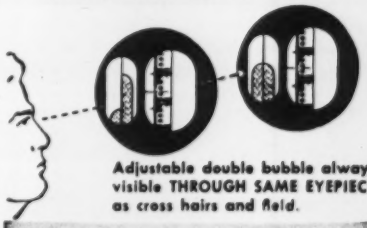
[Applications for Junior membership from ASCE Student Chapters are not listed.]

SURVEYING NEWS

NEW LEVEL WITH DOUBLE BUBBLE IS "MISTAKE-FREE"



Adjustable double bubble always visible THROUGH SAME EYEPIECE as cross hairs and field.

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- American type — erecting eyepiece, 4 leveling screws
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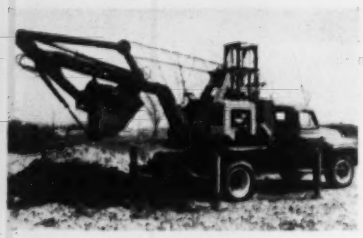
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Wrist-Action Dipper Hydrohoe

A NEW HYDROHOE attachment with wrist action has been developed by Bucyrus-Erie Co., to increase the utility and speed of the H-3 Hydrohoe—its all-hydraulic dragshovel. The new Hydrohoe retains the basic advantages of the standard model but introduces a new additional digging force through a dipper that rotates in a vertical plane through an arc of 65 degrees from a position of 25 degrees ahead of the handle to 40 degrees behind it. The new dipper provides increased digging force, and lessens spillage. It can dig vertical or undercut walls and trenches deeper than they are long. In addition, the operator can change the pitch or rake of the dipper teeth during the digging arc for the best cutting angle and can pry out rocks or expose pipe with less



H-4 Hydrohoe

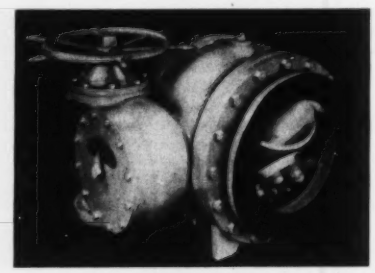
danger of pipe damage. In place of the hydraulically operated earth ejector, the wrist-action dipper is arranged for automatic ejection. A stationary blade or door (optional) around which the dipper rotates ejects the sticky material. The Hydrohoe, with or without wrist-action dipper is offered either as a complete machine or as an attachment for current H-3 Hydrocranes. If desired to convert to wrist-action Hydrohoe, earlier models may be modified to incorporate recommended engineering changes. **Bucyrus-Erie Co., CE 7-116, South Milwaukee, Wis.**

Curta

FIELD PARTIES AND job inspectors required to make frequent on-the-spot computations of a high degree of precision will be immeasurably aided by a new pocket-size computing machine of the single-step drum type. The 8-oz. machine, which is called Curta, can multiply an eight-digit number by a six-digit number and give an eleven-digit answer. Operating like a standard manual office machine, it can add, subtract, multiply, and divide. Additional information about Curta, which is manufactured in Liechtenstein, Europe, can be obtained from **Geo-Optic Company, Inc., CE 7-116, 170 Broadway, New York 38, N. Y.**

Smith Ball Valves

FIRST NATIONAL SHOWING by S. Morgan Smith Co. of Smith Ball Valves for water works, municipal, power plant, and a broad range of industrial applications was held at the Convention of the American Water Works Association. Introduction of the Smith Ball Valve rounds out a complete valve line offered by the York firm, which now includes Smith Rotovalves, Smith Babbitt-Seated Butterfly Valves, and R-S Rubber-Lined Butterfly Valves.



Smith Ball Valves

Both control and shutoff type valves—with manual, pneumatic, hydraulic, and electric operation—are now offered in an extreme range of sizes from tiny one-inch butterfly valves up to 216 inch butterfly valves, with concentration of the lines in 12 inch to 48 inch diameters. Smith Ball Valves, manual type, are designed for 150 p.s.i. working pressures with 125 p.s.i., A.S.A. flanges (C.I.). The valve is comprised of three principal parts: the body, the rotor, and the operating mechanism. Ease of closure, tightness of closure, multiplication of leverage, and freedom from vibration are said to be the principal features of the new line. In addition to standard flanged ends, bell ends or plain ends can be furnished. **S. Morgan Smith Co., CE 7-116, York, Pa.**

Increased Grader Power

A HEAVIER AND more powerful six cylinder Continental gasoline engine has been announced for the Galion 503 grader. Fifty horsepower at 1500 r.p.m. is claimed to provide real lugging ability with less strain and wear on the engine. The heavier engine is also said to be important in the more efficient operation of the many attachments available for the 503 grader. These attachments include rear end loader, windrow eliminator, hydraulic shiftable moldboard, scarifier, bulldozer, "V" and straight blade snow plows, leaning front wheels, and hydraulic circle reverse. It is stated that the wide variety of jobs possible with these attachments make the Galion 503 grader a complete maintenance department in itself. **Galion Iron Works & Mfg. Co., CE 7-116, Galion, Ohio.**

150 H.P. Tractor

A NEW 150 horsepower four-wheel tractor has been announced by Caterpillar. The new tractor, the DW15, is powered by a Cat six cylinder D326 Diesel Engine, producing 150 h.p. at 1800 r.p.m. with $5^1/_8$" x 6" bore and stroke. The engine features aluminum alloy pistons with cast-in-iron band backing for the top compression ring. Chrome-nickel steel heat plugs incorporated into the pistons give longer life. A triple duty oil pump provides positive lubrication on steep grades. Oil can be picked up from the front or rear of the oil pan or from the main oil sump located near the center of the tractor. Standard transmission gives double speed ranges, with 10 forward speeds up to 24 miles per hour and two reverse speeds up to 3.3 m.p.h. Optional final drive gears make

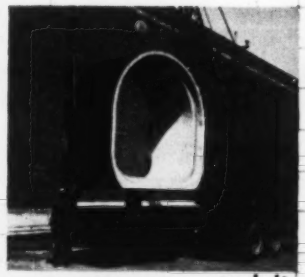
Cat DW15 Tractor

possible speeds up to 31.3 m.p.h. Large capacity wheel brakes are foot pedal controlled and have compressed air boosters. The flywheel clutch has an air booster which reduces clutch pedal pressure when engaging and disengaging the dual, 16 inch metallic clutch plates. Wheel base dimension on the DW15 is $121^1/_2$ inches. Front tire sizes are 12.00 x 20, 14 ply traction type. Rear tires are 21.00 x 25, 20 ply rock type. Improved hitch construction facilitates quick, easy removal of hitch. Front bumper and pull hooks are included as are two headlights on the front and rear bumpers. The tractor features a gasoline starting engine with a 6 volt electric starter. The new tractor, designed for principal use with the Cat No. 15 Scraper, No. 10 Scraper and W10 Wagon, includes wagon controls and windrow breaker. **Caterpillar Tractor Co., CE 7-116, Peoria 8, Ill.**

Portable Power Saw

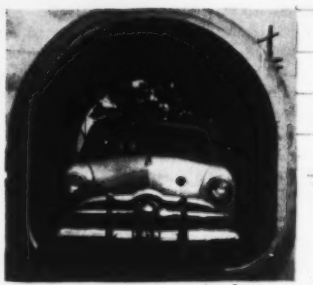
FEATURING A RECIPROCATING blade directly connected to a gasoline engine to form a dynamically balanced, universal wood-cutting tool, Gasoline Wright Saw combines the versatility of a hand saw with the speed of power sawing. It fells trees, saws heavy timbers, yet can be used for precision work such as trimming, notching and ripping. The saw cuts a kerf of

flatten cost curves with UNIVERSAL Flat-base pipe



conduits

highways



industry

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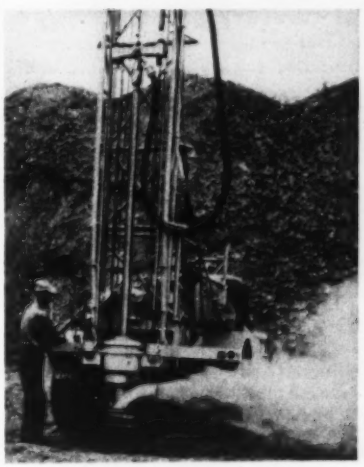
Equipment, Materials & Methods (Continued)

only $^3/_{16}$ in., and leaves a mill surface on the wood. Liberal use of lightweight high-strength alloys results in a machine weighing less than 25 lbs. The 18 in. reciprocating blade eliminates kicking or grabbing so that it does not have to be "wrestled." A special float-type carburetor allows operation in all positions, including upside down. No swivels or special adjustments are required. The throttle is of the trigger variety and includes an unique automatic shut-off feature. The ignition system grounds automatically when the trigger is released, thus stopping the saw instantly. Blades can be changed in 30 sec. and no tools are required. Sharpening is done by hand and requires only a few minutes. **Wright Power Saw and Tool Corporation, CE 7-117, 929 Longbrook Avenue, Stratford, Conn.**

Heavy Duty Air Drill

A ROTARY AIR drill for heavy-duty service, designated as Model M-8A, has been developed for core drilling, water well drilling, structure testing and the drilling of shot and blast holes. Rated capacity of the drilling machine is $5^1/_8$ inch holes to a



Model M-8A Rotary Air Drill

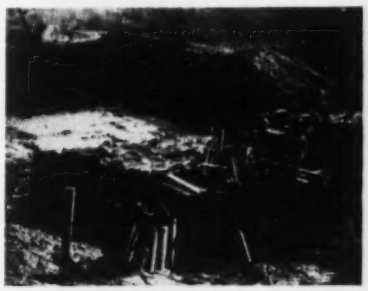
depth of 150 ft with air and $6^1/_4$ inch holes to 1,000 ft with mud. Suitable for mounting on any make of truck, the rotary drill may be driven by a power take-off from the truck engine or by a separate gasoline or diesel engine. Its 8 inch rotary table has a capacity sufficient to support and rotate 100,000 lb loads. Draw works are of the 2-drum type, with line capacity of 470 ft of $^1/_2$ inch line per drum. The machine's mast is of tubular open-face box type construction. It allows for pulling 20 ft sections of drill pipe. Mast is raised and lowered with 20,000 lb rated hydraulic cylinders. Weight of the complete unit, including a recommended truck, is approximately 20,000 lbs. **Davey Compressor Co., CE 7-117, Kent, Ohio**

HOW TO HANDLE WET JOBS

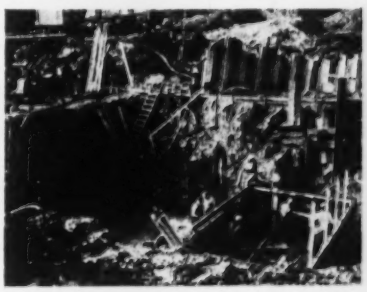
SEWAGE TREATMENT PLANT

Valparaiso, Indiana

Contractor: C & C Construction Co.



BOTTOM UNSTABLE due to quicksand below subgrade. Photo shows collapse of steel sheet piling in this deep excavation for a Lift Station.



WELLPOINT SYSTEM—in new nearby site — solves problem perfectly as water is lowered the required 21 ft and digging speeds ahead by economical open-cut method.

THE soil mixture — clay, silt and fine sand — didn't make life any easier for the Griffin engineers, especially since subgrade, as noted, contained gravel and sand under artesian pressure. The results indicate efficiency of the planning and installation of system.

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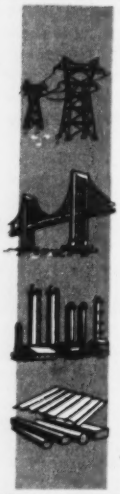

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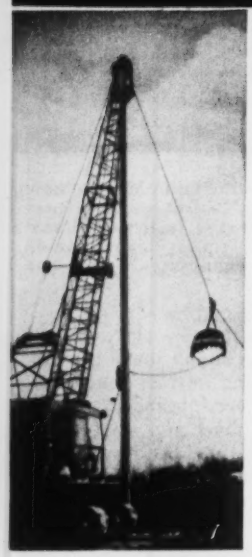

One *Sauerman Scraper* helped by spreading 200 cu. yds. of muck per hour

Spreading 260,000 cu. yds. of plastic material as excavation progressed in the rechanneling of the winding Clyde River was one of the jobs done by A. S. Wikstrom, Inc., in the Thruway construction near Seneca Falls, New York.

A 6-cu. yd. Sauerman Crescent Scraper, equipped with carrier and track cable, working from a 1½-cu. yd. crane handled the job at the rate of 200 cu. yds. per hr. Length of haul was about 300 ft. An Athey Wagon served as an anchor for the track cable and provided the necessary mobility. A spud was used to support the boom and also allowed the operator to take advantage of almost the full boom height for fast gravity return of the scraper to digging point.

This set-up supplanted an earlier recasting arrangement using several machines. It operated at a considerable savings over previous cost.

For more details on the Clyde River project ask for Sauerman News No. 139. Request Field Report 219 and Catalog J. for specific information on the use of scrapers with boom machines. Sauerman engineers will tell you the largest Crescent scraper your dragline or tractor can handle, if you will give us the make and model number of your machine

SAUERMAN BROS., Inc.

552 S. Clinton Street, Chicago 7, Illinois

Equipment, Materials & Methods (Continued)

Shovel Crane

A 1 YD Shovel-Crane, the LS-98 has been designed to meet demands for a machine to combat rising costs, increasing competition and shrinking profit margins. The heavy-duty LS-98 bridges the gap between the application and portability advantages of machines up to ¾ yd size and the output advantage of the larger, heavier sizes. This full 1-yd machine is capable of profitable, high productivity on either large or small production jobs, and scattered operations. One of the big contributing factors to the increased productivity is its "Speed-o-Matic" control. Compared to manually controlled machines in the same class, the LS-98 offers up to 25% more productivity. This additional output is said to result primarily from a combination of two factors: (1) The power hydraulic control system provides faster working cycles and exceptionally easy operation which minimize operator fatigue and end-of-the-shift letdown. (2) The power and stamina of the LS-98 are such that the machine can maintain its faster working cycles without undue wear. A LS-98 when loaded on flat-bed trailer falls within the highway load limits prescribed by many states without major dismantling. This results in a degree of practical transportability said to have never been achieved for a machine of equal output potential. Then, too, the LS-98 features foolproof power steering and two-speed travel gear as standard equipment. The track system is a patented, self-cleaning design. Digging brakes, as well as all traveling, steering and digging functions, are controlled from the operator's position in the cab. It features 14 inch ground clearance with lower frame machinery that is fully enclosed. As a result, there are no under-hanging housings or gear cases to foul or snag. **Link-Belt Speeder Corporation, CE 7-118, 1201 Sixth Street, S. W., Cedar Rapids, Iowa.**

LS-98

Equipment, Materials & Methods (Continued)

Trussless, Clear Span Building

A 100 FOOT wide, 35 foot high building that is a trussless, clear span arch, has been erected in Chicago. This span marks the first time that a trussless clear span arch of this size has been developed for use by commercial and industrial concerns. It is an outgrowth of a patented trussless arch construction developed after many years of research and experimentation. These buildings are called "Wonder Buildings," and can be used for a multiplicity of purposes. An excellent example is storage of any kind, since all space within is available, as no internal beams, pillars, trusses or supports take up space. It can also be advantageously used as a factory, machine shop, warehouse, and recreation building. Further, no space is lost in any size "Wonder Building" because of the wall curvature. In a 30 foot wide structure for example, one can stand $1^1/_2$ feet from the wall and have a distance of 6 feet from floor to ceiling. Construction simplicity is the keynote, as the "Wonder Building" is made up of 3 parts . . . long curved steel sheets . . . short curved steel sheets . . . and a uniform sized nut and bolt. The long and short curved steel sheets are merely fastened together by applying the nuts and bolts in the already punched-out holes. The erection of a "Wonder Building" costs about 75% less than most conventional mason, frame or steel constructions and the cost of the shell is 5 times less than other comparable buildings, running approximately $1.10 per square foot. **Wonder Building Corporation of America, CE 7-119, 30 N. LaSalle Street, Chicago, Ill.**

Washing Plant

A NEW PORTABLE washing plant the Universal Washmaster, is an all electric push button controlled plant designed to meet the need for washing aggregate. It delivers up to four sizes of finished material and has a capacity of 150–200 tons per hour. The plant features a 4′ × 12′ three deck inclined gyrating screen equipped with spray bars and piping combined with a 22" diameter × 25′ long double fine-material screw washer. Delivery chutes permit taking material from any deck of the screen or mixing sizes to meet requirements. The feed conveyor is a 24″ channel frame type with basket hopper. A 36″ horizontal side delivery conveyor which travels slowly, permits hand rejection of unwanted material. An 18″ horizontal side delivery conveyor discharges material from the third screen deck. Both delivery conveyors are folding type for traveling. All are equipped with permanently lubricated troughing and return rolls. The complete plant is mounted on a pneumatic tired gooseneck truck. The Washmaster may be used as a complete plant or may be combined with a portable rock or gravel plant as a complete crushing and washing setup. **Universal Engineering Corporation, CE 7-119, Cedar Rapids, Iowa.**

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Equipment, Materials & Methods (Continued)

Trucks

THE MOTOR TRUCK division of International Harvester Company announced introduction of two new four-wheel-drive models specially designed for use in rough terrain. The two models are the International R-140-4x4, with gross vehicle weight rating of 11,000 lbs, in 130 or 142 wheelbase; and the R-160-4x4, with GVW rating or 15,000 lbs, in 154 and 172 in. wheelbase. Front and rear axles of both models are single reduction hypoid bevel-gear type. Transfer case in both has 1 to 1 to 1.87 gear ratios providing, in combination with the four-speed transmissions, 8 forward and 2 reverse speeds. The transfer case is designed for the mounting of a full torque power-take-off at rear of input shaft. Model R-140-4x4 is powered by the 100 hp International Silver Diamond 220 engine, with a maximum torque of 173.5 at 2,000 rpm. Standard transmission is a sliding gear selective type with four speeds forward and one reverse. Power take-off openings are located on the right and left sides to handle front-mounted winch. Optional transmission is the four-speed, syncromesh, with one power take-off opening. Model R-160-4x4 is powered by the 108 hp International Silver Diamond 240 engine. The SD-240 delivers 108 hp, with maximum torque of 192 at 1,400 rpm. Standard transmission is a sliding gear selective type with four speeds forward, and one reverse, with power take-off openings on right and left sides. Optional transmission is a four-speed syncromesh type with one power take-off. Both models are available with front-mounted winch. **International Harvester Company, CE 7-120, 180 North Michigan Ave., Chicago 1, Ill.**

Wagon Drill

A WAGON DRILL, which eliminates much of the time and effort required for spotting holes, has just been announced. The complete new unit is known as the Model URM, and consists of a drill wagon with dual hydraulic lift, 4 in. drill, and RM chain feed. The drill wagon, Model UMH is equipped with two hydraulic lifts which quickly raise or lower the U-bar while the drilling mast is being maneuvered into position. The wagon carries the chain feed and the heavy-duty Gardner-Denver 4-in. drill. This drill combines fast and powerful hammer action with the ability to keep the steel rotating in bad ground. This steady rotation, plus hole cleaning at full line pressure, plus a powerful pull for extracting steel, means that the URM can save deep holes which otherwise might be lost in broken ground. A single drill control handle, conveniently located within the operator's reach on the chain feed, operates all drilling, blowing and hole-cleaning actions. The URM accommodates 8 ft steel changes as its standard. **Gardner-Denver Company, CE 7-120, Quincy, Ill.**

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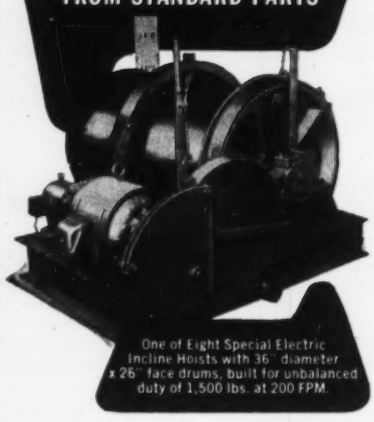

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Literature Available

PLUG VALVES—New 24-page Reference Book No. 39-5 shows Homestead Lubricated Plug Valves in full-port and venturi types, sizes up to 14", and with a choice of self-sealed two-piece plug or one-piece plug designs. Engineering information includes principal dimensions, types of control, metals, lubricants, etc. For your free copy, write **Homestead Valve Manufacuring Company, CE 7-121, Coraopolis, Pa.**

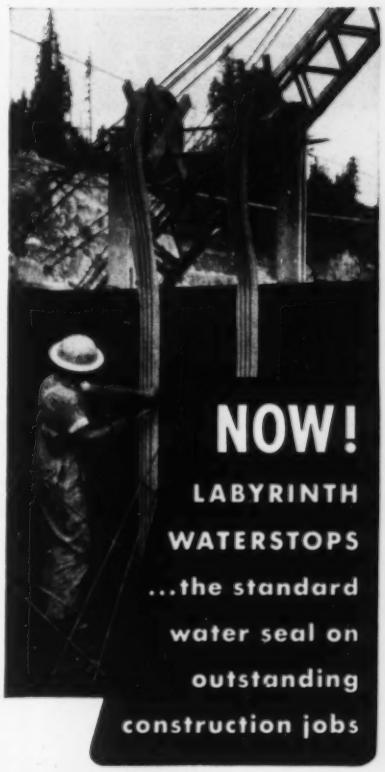
CRANE RUNWAY RAILS—Specifications and other engineering data are included in new literature entitled, "Crane Runway Rails and Accessories." Among the accessories described in the new literature are: crane rails; angle bars; crane stops; rail clips; bolts; hook and anchor bolts; bearing plates. The literature also contains specifications and general information concerning the various sizes of crane rails so that prompt and accurate delivery is assured. **L. B. Foster Company, CE 7-121, P. O. Box 1647, Pittsburgh 30, Pa.**

TUBING & PIPE—A new 8-page booklet "Wallingford Quality Tubing and Pipe" is announced. The booklet's attractive cover lists the variety of quality tubing Wallingford offers—ornamental, mechanical, pressure, sanitary, aircraft and shaped, available from 1/4" to 3" OD with minimum wall of .007" to maximum wall of .148" in stainless, carbon and alloy. Each type of tubing, and the applications for which it is suitable, is explained in detail. **The Wallingford Steel Company, CE 7-121, Wallingford, Connecticut.**

ELEVATORS—A new 2-color, 8-page bulletin HB-54 has been released, illustrating the complete line of Humphrey Manlift Elevators which are used in multifloor buildings where there is vertical processing of products and/or where frequent, quick inspection of machinery on various levels is required. In addition to many "application" illustrations, included are comprehensive product data on the 4 standard models plus information on special equipment for them to meet specific requirements of certain businesses and to comply with varying state codes. **Humphrey Elevator Co., Inc., CE 7-121, Fairbault, Minnesota**

TUBING STEEL—One of the alloy tubing steels widely used in elevated temperature service is discussed in a new technical data card issued by the Tubular Products Division of The Babcock & Wilcox Company. Known as TDC 151, the bulletin discusses B&W Croloy 9M (8 to 10% chromium, 1% molybdenum). Included in the bulletin are data on mechanical and physical properties, bending, welding and heat treatment. **The Tubular Products Division of The Babcock & Wilcox Company, CE 7-121, Beaver Falls, Pa.**

GEOPHYSICAL SURVEYS—A pamphlet, "Geophysical Surveys," describes fully the services offered thru the Geophysical Survey Div. and the uses of the Gahagan Improved Techniques which can give you the full benefit of subsurface exploration by the Geophysical Methods. **Gahagen, CE 7-121, 90 Broad Street, New York 4, N. Y.**



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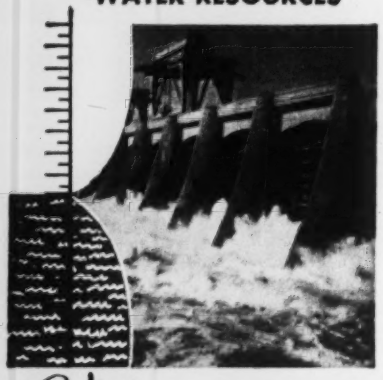

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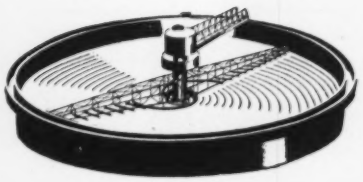
TRACTOR LOADERS—Publication of a new 2-color, 4-page catalog descriptive of Austin Overshot Loader Models 4-C, and 6-C, is announced. The new folder is profusely illustrated with action photos and line sketches. Mechanical features and operating principles are discussed with special emphasis on the exclusive Austin "straight-in-line" loading method. Full specifications are included. Both models are engineered for use with Caterpillar D4 and D6 Tractors, respectively. Copies available at all Caterpillar dealers or write to **Austin Division, Central Ohio Steel Products Co., CE 7-122, Galion, Ohio.**

MOVABLE BRIDGES—A new publication on movable-bridge electrification has been announced as available. The 12-page booklet, designated GED-1982, explains why the nation's automobile and railroad traffic growth necessitates new movable bridges. Amply illustrated, it contains case histories of various bridge applications. Information on amplidyne-control, electrically operated center-span drives, and interlocked control also is provided. **General Electric Co., CE 7-122, Schenectady 5, N. Y.**

HEATERS—Bulletin #543-B, recently released illustrates a line of commercial and industrial, gas fired, warm air unit heaters having output capacities of 88,000 to 160,000 Btu per hour. The four page folder describes the two types; one for suspended mounting and one that can be built into duct type heating or air conditioning systems. Also included are tables listing heating and air delivery capacities, outlet temperatures, air pressure drops, weights and dimensions of the different units. **Dravo Corporation, CE 7-122, 1203 Dravo Building, Pittsburgh 22, Pa.**

CREEP TESTING MACHINES—Five types of creep testing machines for standard sized metal specimens are presented in a new 12-page Bulletin 4208. The lever arm and screw type creep machines, Microformer type and new SR-4 type automatic relaxation machines, and a constant strain rate machine are included in the bulletin with pictures, dimensional diagrams, and specifications. **Baldwin-Lima-Hamilton Corporation, CE 7-122, Philadelphia 42, Pa.**



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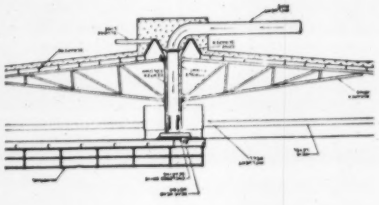

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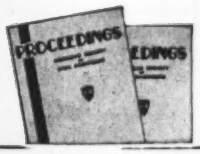

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The following papers have become available as Proceedings-Separates. Following the date of issue of a paper, discussions thereof will be received for a period of three months, as specified on the cover of the paper. Titles will be added to this list every month, as they become available. Technical division sponsorship is indicated by an abbreviation at the end of each item, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. Papers issued prior to, and including, Separate No. 289, were not distributed under the present automatic mailing system. If you have not registered in a Technical Division to receive its papers (one Division only) free of charge, please do so promptly by filling out and mailing the enrollment and subscription form (page 125) to Society Headquarters. For ordering separate papers, use the convenient order form on page 124.

Listed in Earlier Issues

370. Discussions of PROCEEDINGS-SEPARATES 172, 173, and 174. (AT)

371. Discussions of PROCEEDINGS-SEPARATES 106 and 228. (SM)

372. Discussions of PROCEEDINGS-SEPARATES 150 and 226. (CO)

373. Discussions of PROCEEDINGS-SEPARATES 150, 170, 245, and 306. (ST)

374. Discussions of PROCEEDINGS-SEPARATES 157, 202, 223, 299, and 300. (EM)

375. **Deflections of a Circular Beam Out of Its Initial Plane,** by Enrico Volterra. (EM)

376. **Electrical Analogs of Statically Loaded Structures,** by Frederick L. Ryder. (EM)

377. Discussions of PROCEEDINGS-SEPARATES 130, 208, and 231. (SA)

378. Discussions of PROCEEDINGS-SEPARATES 160, 162, 294, and 308. (PO)

January

379. Discussions of PROCEEDINGS-SEPARATES 155 and 215. (SM)

380. **Master Library List of Fluid Mechanics and Hydraulic Engineering Titles: Progress Report of the Committee on Research of the Hydraulics Division.** (HY)

381. **Open Channels with Nonuniform Discharge,** by Wen Hsiung Li. (HY)

382. **Hydraulic Model Studies of Martin Dam Draft Tubes,** by Carl E. Kindsvater, and R. R. Randolph, Jr. (HY)

383. **Backwater Functions by Numerical Integration,** by Clint J. Keifer and Henry Hsien Chu. (HY)

384. Discussions of PROCEEDINGS-SEPARATES 153, 169, and 175. (HY)

385. **Pile Foundations for Buildings,** by John W. Dunham. (SM)

386. **Pavlosky's Theory for Phreatic Line and Slope Stability,** by K. P. Karpoff. (SM)

387. **An Experimental Study of Bubbles Moving in Liquids,** by W. L. Haberman and R. K. Morton. (EM)

388. **Water Supply Engineering: Report of Committee on Water Supply Engineering of the Sanitary Engineering Division for the Period Ending September 30, 1953.** (SA)

389. Discussions of PROCEEDINGS-SEPARATES 152, 271, and 305. (SU)

390. **A New Concept of Flow in Rough Conduits,** by Henry M. Morris. (HY)

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February

398. **Economic Effect of Irrigation in a Subhumid Area,** by Willis C. Boegli. (IR)

399. **Reservoir Malaria Control and Sanitation Problems,** by Frank B. Wood. (SA)

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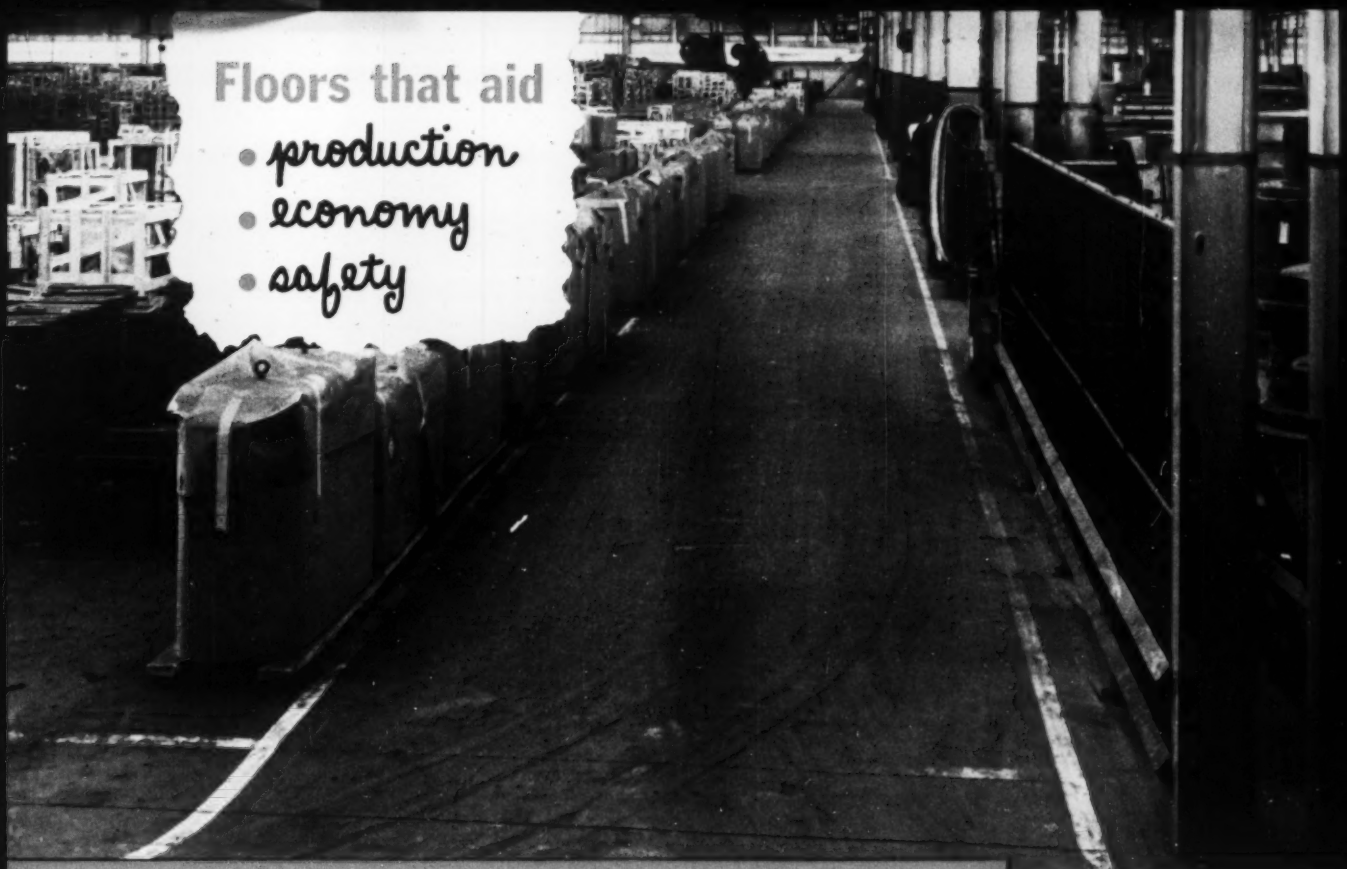

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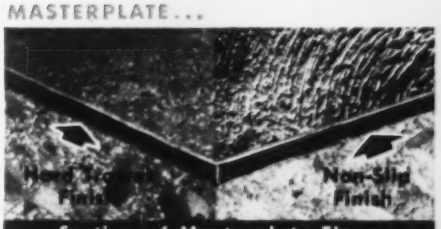

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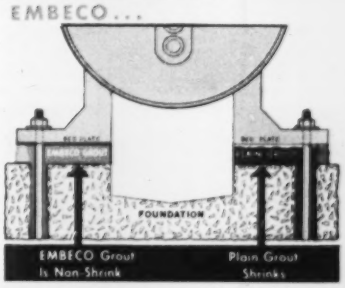

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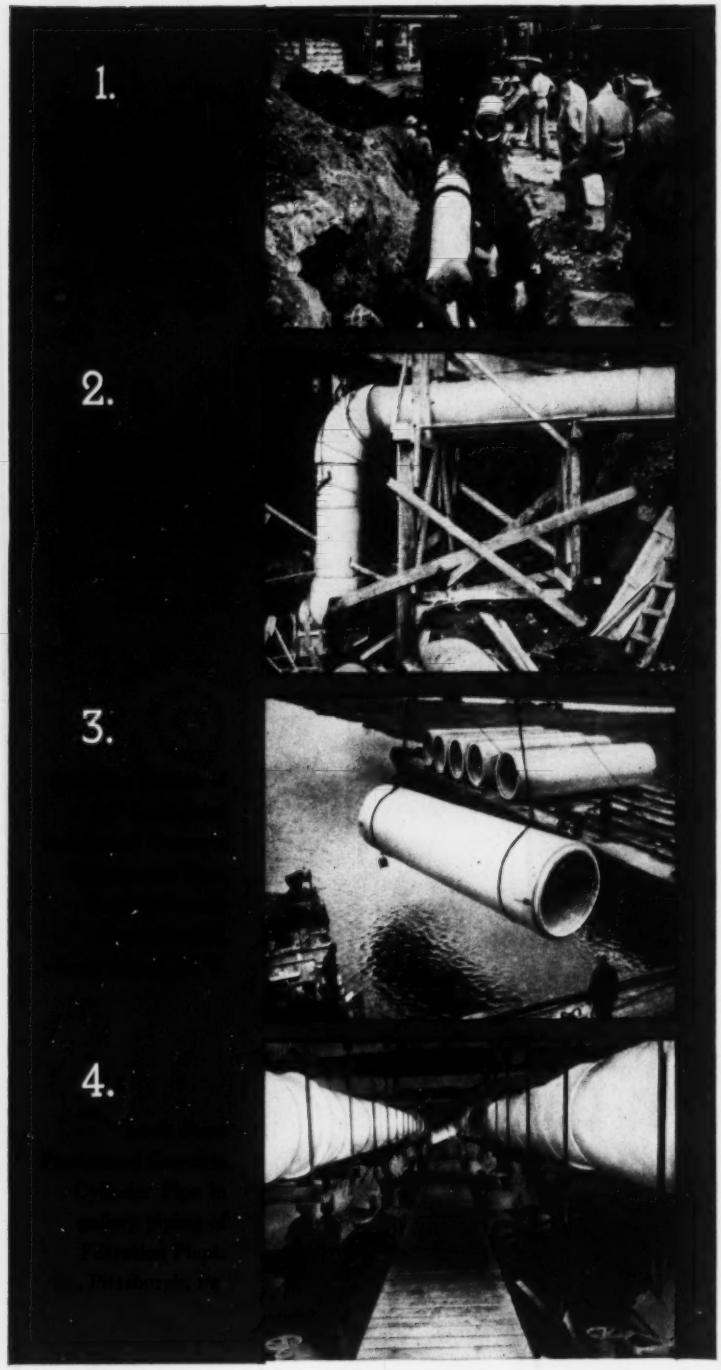

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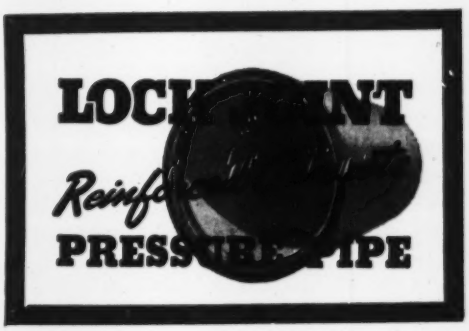
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